ELECTRICAL REVIEW

[ILLUSTRATED.]

A WEEKLY JOURNAL OF

ELECTRIC LIGHT, TELEPHONE TELEGRAPH AND SCIENTIFIC PROGRESS.

(Formerly Review of Telegraph and Telephone.)

Vol. 7, No. 12. WEEKLY. | NEW YORK, SATURDAY, NOVEMBER 21, 1885. | $3 per annum. Single Copies, 10 Cents.

Copyright, 1885, by Electrical Review Publishing Company, 23 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

A New Electrical Standard for Measuring Light.

The illustration on this page will give our readers an excellent idea of the appearance of the new invention of Mr. Edison, known as the "Electrical Standard for Measuring Light." The problem of obtaining a steady light, of known candle-power, and a uniform current from a variable battery, with lamps of varying resistances, has been one which has long occupied the attention of many inventors. In this method of measurement the currents from two batteries are so balanced by the insertion of a variable resistance that, if a galvanometer is inserted in the circuit, no traces of a current can be perceived. The arrangement as shown in the cut consists of a standard constant battery, a galvanometer, a key, a rheostat or resistance wire made in two sections, two adjustable runners which connect the main and constant batteries with the lamp and galvanometer, and a switch, all fixed on a base supported by a metallic tripod. There are four binding posts, which, being placed behind the constant battery, are not shown in the engraving. To two of these binding posts are connected the wires leading from the main battery, and to the other two are attached the ends of a flexible wire leading to an incandescent lamp which may be placed in a photometer. The main battery, which may be a Fuller or other battery, is used for lighting the lamp. The galvanometer is in circuit with both the main and constant battery. In the lamp circuit is a switch for turning the current on or off.

There are two sections of German silver wire placed round the edge of the base, the lower section lying upon a millimeter scale, to any point of which the runner may be adjusted, according to the number indicated on the ticket accompanying each lamp. The circuit of the main battery is from the carbon or positive pole to the lower resistance wire and then back through the lamp to the negative or zinc pole. It will be seen that by sliding the runner the resistance may be increased or diminished. The circuit of the constant battery is from the positive or copper pole through the key to the upper resistance wire, through the galvanometer and back to the negative pole. Here, also, the resistance may be increased or diminished by adjusting the runner.

There is a section of the resistance wire (the amount between the end connecting with the key and the runner on the lower resistance wire), through which the current from each battery flows; and although the current from the main battery has a circuit independent of the galvanometer, it is in this section of wire that both currents are brought into juxtaposition and the electromotive force of the main battery compared with that of the constant battery. The variation is at once noticed on the galvanometer and is easily regulated.

In operating the lamp, the switch in the lamp circuit is first turned on, then the key is pressed, which brings the current of the standard battery into opposition with the current from the main battery, through the galvanometer. If the electromotive force of the main battery is too weak, the needle of the galvanometer, will be sent to the right of zero a few degrees by the constant battery, but such movement is at once overcome by diminishing the resistance in the main circuit through the sliding of the runner on the lower wire toward the left. As quickly as the resistance is cut out by this movement, so is the needle of the galvanomoter forced back to the left until it reaches the zero point; then the batteries are exactly balanced, and the light obtained is equal to that of a standard candle; at this zero reading we have al-o a constant number of volts of electromotive force. So delicate is the balance that the resistance of a quarter of an inch of the resistance wire can be read on the galvanemeter.

The electrical standard of light thus obtained is very constant and reliable. The galvanometer employed is of the ordinary pattern, having an estimated resistance of about 500 ohms. This instrument has been

New "Electrical Standard for Measuring Light," of the Stout-Meadowcroft Co.

for some time in use by the Society of Amateur Photographers of New York, and has given the highest satisfaction for accuracy and efficiency. In addition to its application to photography, the light may be used for many other purposes, such as comparative photometric tests with other kinds of illuminants. It forms a ready and convenient standard for use in the laboratory, or even for use in gas works, and is an improvement which has long been sought for.

*** Bills in equity have been filed in the United States Circuit Court, at Philadelphia, on behalf of the American Bell Telephone Company, against Charles A. Willson and others, Thomas Firth and others, Nathan Snellenburg and others, Thomas J. Martin and others, and Edward Batchelor, asking to have the defendants enjoined from the use of telephones containing improvements said to be an infringement upon the Bell patents.

A Marine Telephone.

An experiment of importance is now being made on the east coast of England by the Telegraph Construction and Maintenance Company. For the last eight months the company has had several of its best operators located in the neighborhood of the Naze, off which the most dangerous sands round England are to be found. These gentlemen are hourly in communication by telephone with the lightship which is anchored 10 miles out, in the vicinity of the Swin passage. An ordinary telegraph cable has been laid from Walton-on-the-Naze to the Sunk lightship, and telephone and telegraphic apparatus have been affixed to both ends. A conversation was carried on with Mr. Stevenson, one of the Telegraph Maintenance Company's officials (who was on board the lightship), by telephone for a considerable time. Mr. Stevenson had been a month upon the boat, and had experienced all kinds of weather, during which time he had kept Mr. Lewis and Mr. Pinkerton, his colleagues on shore, fully informed of the state of the weather, roughness of the sea and passing craft, adding frequently forecasts of weather which usually turned out to be correct. A month upon the lightship is a trying ordeal, but Mr. Stevenson was so satisfied with the success that attended the experiment, and knowing, if the advantage of telephonic communication with lightships was understood and generally adopted, what a splendid boon it would be to mariners and merchants, that he spent his time busily in collecting information and watching the working of his electrical machines. In a back room of of the Walton Post Office are machines for utilizing magnetic currents of all descriptions. A button is touched, which rings a bell in Mr. Stevenson's cabin upon the lightship, 10 miles away, then a voice—that of Mr. Stevenson—is heard inquiring what is wanted. "How is the wind?" "How is the tide?" "Have you seen such and such a ship pass?" "How much water is there in the Swin passage?" These questions can be answered at once. Or the following is transmitted: "Signal such and such a ship that she is to put in at Harwich." Every ship passing is duly signaled, and her name and description telephoned to the Walton Post Office. On an average, 90 ships pass in the day, and if it was known that messages could be sent ashore, no doubt the majority of these would avail themselves of the benefit. The signaling of these passing the lightship would be of great commercial value, as their time of arrival at any port they were bound for could be timed by the owners in London accurately, and everything could be made ready for the landing and sale of the cargo.

Legal Ohm Standards.

After the decision of the Paris electrical congress of 1884, that the standard resistance, or legal ohm, should be the resistance of a column of mercury of one square millimeter cross-section, and 106 cms. in length, at zero Centigrade, it became necessary to construct standards that should represent this resistance. In France this task was intrusted by the Minister of Posts and Telegraphs to M. J. R. Benoit; and in England Mr. R. T. Glazebrook, at the request of the Electrical Standards committee of the British Association, undertook the same work.

M. Benoit attacked the question *ab initio*. From a large number of glass tubes, of about 120 cms. length, and 1 mm. diameter of bore, the four that had the most uniform bores were selected. These tubes were laboriously calibrated to determine the cross-section at every point, and each was then cut off so that the resistance of the column of mercury filling the tube should be as nearly as possible the same as that of the column defined as the standard, The points where the tubes were cut off were determined from the calibration. The resistance of each tube was then calculated from its dimensions, with the following results:

Tube 1=0.999999 legal ohm.
2=1.000004 " "
3=0.999979 " "
4=0.999994 " "

The tubes were then cleaned by passing through them successively strong nitric acid ammonia, and distilled water; then filled with pure mercury, and their resistance compared by balancing them against each other in a Wheatstone's bridge. This comparison showed, that, if the mean of the calculated resistances be the mean of the true resistances, the resistances of the several tubes are as follows:

Tube 1=1.000018 legal ohm.
2=0.999996 " "
3=0.999959 " "
4=1.00..003 " "

Accepting these as the true resistances, M Benoit made a number of secondary standards, of glass tubes doubled upon themselves and bent into compact forms, and with cups at each end for making contact. The resistances of these tubes, when cleaned and filled to certain marks on the cups with pure

mercury, were determined by comparison with the primary standards mentioned above.

Mr. Glazebrook considered it unnecessary, for the construction of the required standards, to go through the laborious process adopted by M. Benoit, for the specific resistance of mercury had been determined in terms of the British Association standards, in several elaborate investigations by Lord Rayleigh, Mascart, Strecker, and others, and so based his standards on the value of the resistance of mercury adopted by the British Association committee; viz.: a column of mercury at zero Centigrade, one meter long, and one square mm. cross-section, has a resistance of .9540 B.A. unit

Mr. Glazebrook has made a careful comparison of his legal-ohm standards with those made by Benoit, and finds that there is a difference of .0005 ohm between them, the Benoit standards being less by that amount.

Two of these Benoit standards gave different results at different times. For instance, one whose resistance had been designated as 1.00045 legal ohm by Benoit, showed, when first filled, the same resistance in terms of the Cambridge stardards; the next day its resistance was found to be 1.00071, and, on flowing the mercury back and forth through it, it rose to 1.00080. The tube was examined, but no trace of an air bubble was seen. It was then cleaned and filled again, and afterwards gave consistent results, the mean being .99990 legal ohm, though the same precautions were taken in the first filling as in the last. This result indicates the uncertainty of mercury standards, and the extreme care that is required to obtain consistent results. Every mercury standard should be made of such a form that the tube can not only be washed, but wiped out by some mechanical means. It is important to notice that the rate at which the resistance of mercury varies with the temperature has been examined lately by Mr. Glazebrook, and he finds that the rate of change diminishes rapidly as we approach 0°; the average change between 0° and 5° being .000834, while between 0° and 15° it is .000879.—*Science.*

Wonders of the Sea.

The sea occupies three-fifths of the surface of the earth. At the depth of about 3,500 feet waves are not felt. The temperature is the same, varying only a trifle from the ice of the pole to the burning sun of the equator. A mile down, the water has a pressure of over a ton to the square inch. If a box six feet deep were filled with sea water and allowed to evaporate under the sun, there would be two inches of salt left on the bottom. Taking the average depth of the ocean to be three miles, there would be a layer of pure salt 230 feet thick on the bed of the Atlantic. The water is colder at the bottom than at the surface. In the many bays on the coast of Norway the water often freezes at the bottom before it does above.

Waves are very deceptive. To look at them in a storm one would think the water traveled. The water stays in the same place, but the motion goes on. Sometimes in storms these waves are forty feet high, and travel fifty miles an hour, more than twice as fast as the swiftest steamer. The distance from valley to valley is generally fifteen times the height, hence a wave five feet high will extend over seventy-five feet of water. The force of the sea dashing on Bell Rock is said to be seventeen tons for each square yard. Evaporation is a wonderful power in drawing the water from the sea. Every year a layer of the entire sea, fourteen feet thick, is taken up into the clouds. The winds bear their burden to the land, and the water comes down in rain upon the fields, to flow back at last through rivers. The depth of the sea presents an interesting problem. If the Atlantic were lowered 6,564 feet, the distance from shore to shore would be half as great, or 1,500 miles. If lowered a little more than three miles, say 19,680 feet, there would be a road of dry land from Newfoundland to Ireland. This is the plain on which the great Atlantic cables were laid. The Mediterranean is comparatively shallow. A drying up of 660 feet would leave three different seas, and Africa would be joined with Italy. The British Channel is more like a pond, which accounts for its choppy waves.

It has been found difficult to get correct soundings of the Atlantic. A midshipman of the navy overcame the difficulty, and shot weighing thirty pounds carries down the line. A hole is bored through the sinker, through which a rod of iron is passed, moving easily back and forth. In the end of the bar a cup is dug out, and the inside coated with lard. The bar is made fast to the line, and a sling holds the shot on. When the bar which extends below the ball, touches the earth, the sling unhooks and the shot slides off. The lard in the end of the bar holds some of the sand, or whatever may be on the bottom, and a drop shuts over the cup to keep the water from washing the sand out. When the ground is reached a shock is felt as if an electric current had passed through the line.

The Modern Steam Engine.

The era of electric-lighting, which has been fairly inaugurated in all our large cities, promises to revolutionize the use of steam as applied to stationary engines. It has created a large demand for a class of high-speed, automatic cut-off machines, which are essentially different in their working and construction from the old throttle-valve engine, and are also a great improvement upon it for special purposes as well as general utility.

This improvement consists not only in securing greater power and speed but in greater economy in the consumption of steam, the new engine utilizing its expansive force in the cylinders more completely and with less waste than in the old one; and especially in the steady and uniform rotatory motion produced by the reformed and perfected machine as used in the plant of electric-lighting companies. The action of this machine is governed so as to produce a perfect regularity of stroke in the piston-rod, and hence there is no uneven, spasmodic or jerky revolution of the dynamo, such as would momentarily interrupt or greatly diminish the volume and force of the electric current, and render the light at the end of the circuit flickering and unsteady Moreover, the rapidly-working engine, owing to the more frequent impulses it receives from the expansive force which moves it, develops a greater amount of applied power than the slow one in a given time.

These modern improvements in the high-speed engine, rendered necessary by the new uses to which it has recently been put, are gradually extending to all departments of industry in which steam-power is used. Manufacturers have discovered that it pays to get the most perfect and smooth-running machines that can be made, and that the saving of time and fuel from the adoption of the latest improvements in engine building and designing will soon reimburse the cost of making a change from the old to the new.

It is no easy matter to make a good engine, perfect and nicely adjusted in all its parts, even of the old pattern. Yet it is still more difficult to design and build one which meets all the extended requirements and demands of modern usage, especially one which is adapted to the service of machinery which needs to be run at a high rate of speed. Such a machine cannot be slighted in any of its parts or appliances. Its construction requires not only a higher grade of mechanical skill for its perfect adjustment and finish than was needed in former times, but also a wider range of scientific knowledge in regard to the nature and operation of forces.

The practical machinist and inventor now a-days must needs be also a technical scholar, versed in the higher branches of mathematics and engineering. Were it not for these qualifications, the steam-engine of to-day would not be what it is, a marvel of applied science and mechanism, a concrete embodiment of profound philosophic thought, which has taken shape like a thing of life and intellect. If the practical mechanic and the scientific explorer had not joined their forces and formed a partnership, the ascertained fact that luminous dynamic electricity may be generated by rapidly revolving an armature composed of spiral inductive coils of covered wire between the poles of an ordinary field magnet, would have remained, like other mere curiosities of science, a barren discovery.

But few, even among the wise and the learned, will ever be able to realize how much the power of steam, in its various applications to the useful arts, in a constantly broadening field, is indebted to the researches of the modern student in chemical and electrical science.—*Manufacturers' Gazette.*

The Pitman and the Telephone.

At one of our Northumbrian pits, lately, the telephone has been laid into the clerk's office. As a matter of course, the introduction of such a wonderful piece of machinery created a no small amount of gossip in the district, and the powers of the instrument were exaggerated by the good people of the village to an enormous degree. A well-known pitman, noted for his inquisitiveness, made overtures to the office boy to allow him to have a try at the telephone. A Saturday afternoon was fixed (of course, when the coast would be clear) for the trial, and Geordy was ushered into the presence of the mysterious box and tubes. "Stand heor," said the boy, pressing the white knob, "an aa'll ring the beggors up at Newcastle. Tyek haad o' these tubes, and taak when ye heor the bell ring." Presently the bell began to tinkle, and Geordy, with a tube in each hand, seemed to be puzzled over something. The bell kept on ringing. "Gan on, man; taak," said the boy. Geordy put one of the tubes to his mouth, and shouted with all his might, "S op that bell." "Get oot, ye feuyl," exclaimed the boy, "taak iuto the box." "Hoo on airth can aa taak into the box when the lid's on't?" excitedly said Geordy. Still the bell went on ringing. "Oh, dear me," gasped the youth, "what ignorance! Ye hev to haad yer mooth ower the box and taak." "Haad the pipes to yor lugs ye donkey!" shouted the boy, or "hoo'll ye heor?" Geordy did as he was told, and he distinctly heard, "Are you there? How much longer are you going to be?" Geordy, astonished, looked under the box, and then said, "That box is far ower little to haad onybody, or else he mun be a varry little chap that's in't." "There's somebody knockin' at the door," said the boy, "aa'll away doon and see we it is; ye knaa how to de noo Aa'll be back doreckly." Geordy again placed the tubes to his ears, and again he heard the words, "Are you there? What r-l-l-r-do r-l-l-you-r-lr-want?" Geordy was somewhat puzzled at this last question, and more particularly at the rumbling sound he heard; an idea, however, struck him, and the following conversation ensued: Geordy—"Wheer are ye?" Telephone—"At the Newcastle office, to be sure. Who do you want to be put into communication with." G—"What de'ye mean?" T.—"Who do you want to speak to?" G.—"Oh, that aad lass o' mine; she's at Newcassel." T.—"Who-llr-r-r-r lr-do-rrrllrr-you-llr'say?" What is—l-l-r-r r-l-l-r-r—the number?" G.—"What are ye gobblin' on that way for? Aa cannot myek oot what ye say. Aa want to speak to ma wife; she's at Newcassel. An' what d'ye mean be axin hor numbor—she's not a pollis, ye feuyl." Then there was a loud crash. The person at the Newcastle office had evidently hit the telephone a sharp rap, producing, of course, to the listener sounds like an explosion. Geordy dropped the tubes and rushed down the stairs as fast as he could, nearly knocking over the office boy, who was just then returning. "What's the mettor?" shouted the boy. "What's the mettor?" returned the retreating Geordy; "dinamite! dinamite! thor's somethin' borsted!"—*Newcastle Chronicle.*

* * M. Delauney, of Paris, predicts that earthquakes on a grand scale will occur next year, either when the earth is under the influence of a planet of the first rank, such as Jupiter, or under that of a group of asteroids, or at a time when the sun and moon are nearest to our planet simultaneously.

Aluminum.

By P. H. Van der Weyde, M.D.

As an introduction to the following account of the various successive steps in the attempts to manufacture aluminum at a price which will make it possible to utilize its remarkable useful qualities, it may be interesting to give an extract from a paper read by Deville before the *Soiree Scientifique de la Sarbonne*, in Paris; as Deville is one of the greatest pioneers in this line of pursuit, his statements are worthy of consideration.

THE FIRST DISCOVERER OF ALUMINUM.

Deville said: "I am indebted to General V. Béville for the following, which he has found in the old Roman authors: A poor mechanic understood how to extract from clay glass a decidedly metallic substance; out of this he made a dish, which he offered to the Emperor Tiberius. The emperor accepted the dish, and praised the workman very highly, when the latter, in order to show to the emperor the valuable qualities of the dish, threw it on the floor, when it did not break, but only bend, and could again be put in proper shape by a pair of blows by a hammer, showing that it had the same qualities as gold and silver, the latter of which it resembled in color. Being manufactured out of clay, it could be nothing else but aluminum. The workman was asked if he alone did know the secret to make a metal from clay, and he answered that he himself only and Jupiter the God of Heaven did know it. Then Tiberius, fearing that his own silver might lose much of its value when so common a metal as could be extracted from clay had similar qualities, ordered that the workshop of the mechanic should be destroyed and the workman himself beheaded, and this was done."

Deville quoted then the closing sentences of General V. Béville in his report of the above mentioned facts; they were as follows:

"I hear that Mr. Deville, who was also guilty of the aluminum crime, has undergone quite a different treatment from the French Emperor, than the Roman mechanic received from the Roman Emperor Tiberius."

Napoleon III. namely, paid all the expenses of Deville's researches on aluminum.

THE MANUFACTURE OF ALUMINUM.

In order to attain a clear understanding of some of the modern, often very complicated chemical operations, it is useful as well as instructive to review the various experiments by which the present methods have been developed; in other words, to study the history of the gradual progress of the subject under consideration. This is especially the case with the manufacture of aluminum, of which common clay may be considered an impure ore, but of which purer ores are very common; in fact, it is one of the most widely diffused metals, forming the prevalent substance in feldspar, granite, porphyry, trachite, cyanite, cryolite, kaolin, etc. The only difficulty being that the aluminum metal, which is the main base of these substances, has such strong affinities to the substances with which it is combined, that the ordinary means successful in extracting metals from their ores, fail here entirely.

The valuable property of carbon to have at a red heat, its affinity for oxygen so much increased as to separate the oxygen from metallic ores, has from time immemorial been in use for the reduction of many metals, especially iron, but unfortunately the aluminum ores will not yield to this agent, and other means are required consisting in transforming the ores into other compounds, which afterward may be made to yield the required element.

FIRST STEP BY OERSTED.—ALUMINUM CHLORID.

It was Oersted, of Copenhagen, who by experimenting, found that when a current of chlorin gas is passed through alumina (oxide of aluminum), mixed with pulverized carbon, and submitted to the influence of a red heat, the alumina will yield its oxygen to the carbon, and form carbonic acid gas, which escapes, while the aluminum will

combine with the chlorin and form the chlorid of aluminum. Without the aid of chlorin, and the consequent action of the double affinity (namely, of the carbon for oxygen and of the chlorin for aluminum), the alumina would not give up its oxygen. The aluminum chlorid must be preserved in glass stoppered bottles.

SECOND STEP BY WOEHLER.—POTASSIUM PROCESS.

The next step was the attempt to reduce the aluminum chlorid to the metallic state. This was made by Woehler, who conceived the happy idea to make use of the intense affinity of metallic potassium for chlorin, especially under the influence of heat. He places some pieces of clean potassium with about an equal quantity of aluminum chlorid in a porcelain crucible, provided with a cover fastened to it by wire, and heats it gradually over the flame of an alcohol lamp; soon the combination of the potassium with the chlorin shows itself by the noisy and fiery mass inside, which suddenly brings the crucible to a red heat; the crucible is left over the alcohol lamp a little longer, th n allowed to cool, and thrown in cold water, which will dissolve the potassium chlorid and leave the aluminum behind, in the condition of a gray powder, similar to pulverized platinum sponge.

THIRD STEP BY DEVILLE.—SODIUM PROCESS.

This method has since been improved upon by substituting sodium for potassium, with a triple advantage: first, that it is considerably cheaper; secondly, that its atomic weight is smaller, wherefore a lesser quantity of sodium will accomplish as much as a larger quantity of potassium; and lastly, that being less volatile, there is less loss by evaporation.

The manipulation has also been improved upon by placing the aluminum chlorid in a tube of hard glass, between two loose plugs of asbestos, heating it, and passing first a current of dry hydrogen through, so as to eliminate the hydrochloric acid and chlorids of sulphur and silicium al ways present in alumina; small pieces of sodium are then introduced, each previously compressed between two pieces of dry filtering paper, and placed in porcelain capsules; the heat is then increased, and the tube being filled with hydrogen, the sodium will melt without taking fire, while the aluminum chlorid is decomposed under the development of a red heat. The operation is finished when all the sodium has disappeared, and the sodium chlorid (common salt) which has been formed, has absorbed aluminum chlorid so as to form the double chlorid of aluminum and sodium, which is very perishable and volatile. For the latter reason it is easily disposed of by heating the capsules in another tube under a current of hydrogen, when it will evaporate and leave the aluminum behind, which then is collected from the capsules and heated in a crucible of fireproof clay, when by compressing the heated mass with a piston, the parts will unite, and can be cast in a mould.

FOURTH STEP BY ROSE.—CRYOLITE PROCESS.

Percy announced already in 1855 that he had extracted metallic aluminum from cryolite,* while at the same time Rose published the details of the operation. He mixes the cryolite with half its weight of common salt, and places alternate layers of the mixture with plates of sodium in a crucible, until it is full. The upper layer is cryolite alone, and on top of this, salt. The crucible is rapidly heated until all is fused, when it is well stirred with a stick of fire-clay. After cooling, the crucible is broken, when the aluminum is found in large globules, easily separated from the rest. It contains almost always silicium, which increases its bluish color, which cannot be corrected by nitric acid, for reason of the insolubility of silicium in this acid, while other impurities contained in aluminum as produced by any of the processes as described above, may be corrected by nitric acid, while the impurities there obtained are iron and other substances soluble in nitric acid.

It should also be remarked that it has been found that the metal obtained in this way is of such a mixed character as to contain only a comparatively small amount of pure aluminum.

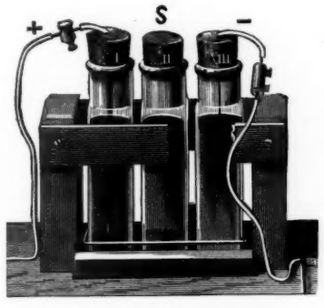
FIFTH STEP.—NO MORE SODIUM, BUT ELECTRICITY.

The most important improvement was the application of electrolyse. It consists simply in passing a sufficiently strong electric current through the fused double chlorid of aluminum and sodium, which is made by mixing two parts of chlorid of aluminum with one part of common salt. It will be seen that in this process the use of the expensive sodium is entirely dispensed with, so that the old notion that the production of cheap aluminum depends upon the production of cheap sodium is exploded, sodium not being wanted at all, the electric current taking its place. The aluminum chlorid and salt are dried, mixed and heated in a porcelain crucible to 390° Fahrenheit. Very soon a combination takes place with the development of heat, and a very fluid mass is obtained, which is submitted to the decomposing action of the electric current. To do this safely the porcelain crucible is placed in a larger one of fire-clay, furnished with a cover, in which there is a slit; through this a platinum plate is passed, which serves for the negative electrode, while through a large central opening a dry cylindrical porous cup is passed; both are plunged in the liquid mass; in this porous cup a cylinder of battery coke or a heavy arc-light carbon is placed, it serves for the positive electrode. The same mixed chlorid of aluminum and sodium is also placed in the porous cup. When the current is started the aluminum is deposited, with common salt, upon the platinum electrode, while chlorin gas and a small quantity of aluminum chlorid goes to the carbon and escapes from the interior of the porous cup; the quantity of vapor evolved there can be reduced by adding from time to time pulverized dry common salt in the porous cup. This salt is, during the operation, transmitted to the negative pole, and deposited with the aluminum. The platinum plate is from time to time taken out, so as to remove the metallic and saline deposits, and rapidly re-introduced into the crucible. These deposits are re-heated, and after cooling the salt is washed out, when the aluminum remains behind as a gray metallic powder, which by repeated fusions can be obtained as ingots. However, by this method the metal obtained is brittle, for reason that the materials used are not purified so well by this operation, as is the case when using the sodium process described above. However, when a purer chlorid of aluminum is used, the metal is just as good and pure as that obtained by the sodium process.

SIXTH STEP—THE DYNAMO PROCESS.

As for the process just described, very powerful electric currents were required, involving the use of very large galvanic batteries, there was no economical advantage in its application, as the cost was about the same, if not more, than that of using sodium without battery currents. Consequently, the process did not fulfill the great desideratum—the cheap production of aluminum—and did not come into commercial use. However, the invention of producing cheap electric currents, by the application of steam, water or wind power to dynamo-electric machines, has entirely altered the circumstances, and now the production of aluminum, at a cheap rate, is a possibility, and in practical operation in Europe, and in this country by the Messrs. Cowles, of Cleveland, Ohio, who have made important improvements in the process, and use a dynamo-electric machine requiring an engine of 30 horse-power to drive it, producing a proportionally strong current. The current is conducted into a mixture of alumina and carbon by means of electrodes of carbon, of one and a half-inch diameter, while the heat produced by the current is great enough not to require any additional fire under the crucible, or rather fire box of fireproof clay, in which the operation is conducted.

It is seen that the intense heat produced by the electric current, forced through a mixture of high resistance, as is that of alumina and carbon (with the exclusion of an air-blast, which, in the reduction of iron, forms carbonic oxide and carbonic acid,) is capable to compel the oxygen in the alumina to leave the latter, combine with the carbon, and, attacking the latter, escape there as gas, while partially metallic aluminum will be deposited around the negative electrode, and partially a chrystalline compound of aluminum and carbon. If this electrode is copper, in place of carbon, an alloy of aluminum and copper, or aluminum-bronze, is directly obtained. This has already become an article of trade and is sold in different grades, of which the price is estimated according to the amount of aluminum in the bronze, and valued at $5 per pound of the contained aluminum.



THE WIRT CONSTANT BATTERY.

It has been found that 2 to 5 per cent. of aluminum improves copper very much, giving it greater strength; 10 to 15 per cent. of copper in aluminum gives the latter a much greater tenacity and hardness, which promises to furnish a new and very useful alloy.

Experiments are now in progress to apply the same process to the extraction of other rare elements, such as boron, silicon, etc. Ten new dynamo-electric machines, requiring 125 horse-power each, are in course of construction, while the Cowles Electric Smelting Company have secured large water-power therefor at Lockport, N. Y. It appears that a new era is dawning in electro-metallurgy—in fact, nothing less than a complete revolution; while the dream of the alchemists, of a universal solvent and reducing agent for all ores, appears to be solved by the dynamo-electric machine.

SEVENTH STEP—ELECTRO-PLATING WITH ALUMINUM.

I will close this account with stating that Mr. Bell has patented in England a process to electro-plate various metals with aluminum. For this he uses the anhydrous double chlorid of aluminum and sodium above described, which he brings into a fluid condition by melting it over a fire and keeping the temperature at 360° Fahr. The substance to be coated with aluminum is immersed and connected with the negative electrode, while an aluminum plate is used as positive electrode, or, what is cheaper, a plate made of carbon and anhydrous alumina, baked together in the way that battery carbons, or arc-light carbons, are made. In place of the double chlorid of aluminum and sodium, cryolite can be used, which is a double fluorid of aluminum and sodium; this, however, requires a much higher temperature to keep it liquid. In order to make aluminum bronze, a copper plate can be covered in this way with aluminum, and then heated to the proper temperature, when the metals will unite and form bronze.

* See about Cryolite, ELECTRICAL REVIEW for October 3, p. 8.

The Wirt Constant Battery.

This battery, which is a modification of the Daniell, is comparatively new, and is so constructed that the fluids cannot be disturbed or mixed through any ordinary jarring. The battery consists of three square bottles, 1¼ inch square by 4½ inches high, with a neck ⅞ of an inch in diameter by one inch long, securely clamped together at the top and bottom, at shown in the engraving. In the upper part of the adjoining sides of bottles *I* and *II* is drilled a small hole ⅜ of an inch in diameter, and in the lower part of the adjoining sides of bottles *II* and *III* are similar holes, all arranged to correspond with each other. A soft rubber washer separates the bottles at the holes, making a water-tight joint, and also acting as a support to hold in place a thin film of gold-beater's skin, through which the liquids must pass by the process of endosmose and exosmose, from one bottle to the other. All the bottles are filled with a dilute solution of sulphate of zinc; within bottle *I* is placed a piece of sulphate of copper about the size of a pea, which changes the solution to a blue color; the copper electrode at the bottom is connected by an insulated wire, which passes through the cork. At the bottom of bottle *II* is a small piece of zinc which collects any deposit of sulphate, should any pass through from bottle *I*. The zinc electrode is suspended from bottle *III*.

This arrangement, the owners—the Stout-Meadowcroft Co., of this city—of the Wirt battery state, gives a very constant battery which cannot polarize, as each electrode is completely isolated, and the separation of the bottles with the gold-beater's skin also prevents an easy mixture of the solutions. Each electrode is never endangered, but is kept immersed in a solution favorable to retain it in perfect condition.

*** The Grand Rapids Telephone Exchange has 800 telephones in use in the city, an increase of about 200 in the past year, and the number is still further increasing at the rate of from 20 to 30 a month. The city is connected telephonically with over 100 towns, villages and cities in Western Michigan, and with a copper wire would be able to communicate with Detroit and other points on the east side. The copper wire will probably be put up next year. At the present time the telephone officials do communicate with Detroit and also Toledo, and even further, when the conditions are favorable for the transaction of their own business.

*** One of the cases which will come up at the present term of the United States Circuit Court, at Pittsburgh, is that of the Bell Telephone Company against the Western Pennsylvania Telegraph and Telephone Company. This case has been argued and a preliminary injunction was granted, but the broad issue, involving the merits of the whole question of priority of invention is yet to be determined. A large amount of scientific testimony, which was taken before a special master in New York, was filed in the Circuit Court Clerk's office last week. It is possible that a sweeping decision in favor of Bell by the patent authorities in the nine cases now before them, may settle this case, but it is understood that it will be fought on its own merits to a conclusion. The array of attorneys and experts now engaged in the cases at Washington will, no doubt, come to Pittsburgh to engage in the trial there.

Electrical Review.

Published at 23 Park Row.
P. O BOX 3329.

GEO. WORTHINGTON, - - - Editor.
CHARLES W. PRICE, Associate "
LOREN N. DOWNS, President.
C. C. HASKINS, GEO. A. HAMILTON, JOHN W. BEANE, } Consulting Electricians.

SUBSCRIPTION.

United States and Canada, $3.00 per annum, in advance. Postage paid by publisher.

Great Britain and other foreign countries, $4.00, in advance. Postage paid by publisher.

ADVERTISING.

Transient, 25 cents per line, nonpareil.

EDITORIAL ANNOUNCEMENT.

Address all communications and make all checks and P. O. orders payable to order of ELECTRICAL REVIEW P. O. Box 3329, New York

We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity and those engaged in Electric Lighting on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

Mr. J. Viennot, 150 South Fourth Street, Philadelphia, is our accredited representative for Pennsylvania.

Mr. C. C. Haskins, 118 LaSalle Street, Chicago, Ill, will represent the REVIEW in the West.

Messrs. Wm. Dawson & Sons, 121 Cannon Street. London, England, are our representatives for Great Britain.

NEW YORK, NOVEMBER 21, 1885

CONTENTS.

	PAGE
A New Electrical Standard for Measuring Light	1
A Marine Telephone	1
Legal Ohm Standard	1
Wonders of the Sea	2
The Modern Steam Engine	2
The Pitman and the Telephone	2
Aluminum	2
The Wirt Constant Battery	3
Editorial Notes	4
Reduced Rates for Electric-Light People	4
Inductional Transformers	4
Automatic Sprinkler for Extinguishing Fires	4
National Electric-Light Association	4
General Western News	5
The Induction Problem	4
Mayor Grace's Inquiries in the Underground Wire Matter	5
Telephone News	6
The Telephone Hearing	6,7,9
The New York Subway Commission	9
Electric Light News	9
Electrical Patents	10

An excellent indication of the activity in electrical circles is to be found in the long list of patents published each week in the REVIEW. A great many bright and inventive minds are devoted to the cause of electrical science. And the REVIEW hopes that each may receive his reward.

The value of time is strikingly shown in the evidence in the telephone case at Washington. Prof. Bell, it is proven, filed his application for a patent three hours before Prof. Gray filed his caveat relating to the same invention. Those three hours were worth millions to Prof. Bell, as well as several other gentlemen.

Where a telegram is transmitted to an office after the office hours, the company does not become liable for the statutory penalty for a penalty to transmit. The penalty is not incurred unless there is a failure to receive and transmit during the usual office hours, both at the point where the message is received and that to which it is transmitted. So held by the Supreme Court of Indiana, in the case of Western Union Telegraph Company *vs.* Harding, decided November 6.

REDUCED RATES FOR ELECTRIC LIGHT PEOPLE.

Mr. Geo. H. Wadsworth, Chairman of the Transportation Committee of the National Electric Light Association, requests us to announce that all delegates and their families and all dealers in electrical apparatus and supplies, attending the meeting of the Association to be held in Baltimore next February, will be accorded reduced rates over all lines leading into Baltimore. The detailed rates will be announced in the columns of the REVIEW early in January. Those who desire to make arrangements for special parties can secure reduced rates and sleeping car accommodations on application to the proper authorities of the different sleeping car companies, who will undoubtedly be glad to furnish the same.

INDUCTIONAL TRANSFORMERS.

Lack of space prevented reference to the interesting communication of Messrs. Ganz & Co., in our last issue, but there are one or two points which seem to require notice. As regards an arrangement in parallel arc, it is not so definitely settled as might be inferred, that it is the best under the circumstances under which inductional transformers would work in general practice as distributors of electricity. It is a system of distributing electricity upon which its claims are based, and it is in this light that it must be judged, and, although six months have already passed since it was first installed as a system for *incandescent lighting* at the Buda-Pesth Exhibition, wherein its perfect operation has been exceedingly gratifying, yet it is still impossible to define its status as a "new system of distributing electricity" until we have learned of its operation in an extensive system of distribution, including lamps of different types.

AUTOMATIC SPRINKLERS FOR EXTINGUISHING FIRES.

Within the past eight years great perfection has been attained in the construction of apparatus of this mode of protection against fires, and their remarkable record for efficiency and prompt action fully accounts for their extensive installation upon factory and mill plants, and, in fact, all characters of industrial properties. This is a very important subject to property owners and manufacturers, and a very interesting and complete history of sprinklers was given by Mr. C. J. H. Woodbury, Inspector of the Factory Mutual Insurance Companies of New England, in a lecture recently delivered before the Boston Society of Arts. The general character of all forms of automatic sprinklers is a system of overhead pipes, the flow of water from which is obtained from the heat of the conflagration itself by the melting of solder closing orifices or valves therein.

Though this matter may appear, at first blush, easy of accomplishment, a more careful examination of the long list of failures will soon disabuse the mind of such an idea. Although a solution of the problem was attempted as far back as 1806, it has only been within the last few years that anything like success has been attained. "The motive in all the automatic inventions," says Mr. Woodbury, "seemed to be the desire to effect the distribution of the water, rather than to give due consideration to the eminently practical questions of the ability of the device to retain for a long time a head of water, ready for instant use, without being affected by any deteriorating influences due to the effects of corrosion or pressure." This seems to have been the rock upon which they split.

However, one obstacle after another has been removed, after many disheartening experiences, and to-day the records of the Parmelee, Grinnell, Burritt, and other systems attest the success attained.

A correct estimate of the value of automatic sprinklers may be obtained from the record of fires on property insured by the Boston Manufacturers' Mutual Fire Insurance Company from 1877 to 1884. The average loss per fire where sprinklers were not fixed was $7,794.05, whereas, on the other hand, where the property was protected by sprinklers, the loss amounted to only $331.82 per fire! In the record of all fires cited in this connection, nearly thirty-nine per cent. are followed by claims, while of the automatic sprinkler fires alone, about thirty per cent. result in an appreciable loss.

ELECTRIC-LIGHTING MEN, ATTENTION!

It is with no little pleasure that we inform our readers of the interest which the whole electric-lighting community is taking in the National Electric Lighting Association. We learn that the membership is increasing, and that the financial support necessary to place the association on a firm footing and insure its permanence is being generously given.

We take pleasure in recording this fact, because we know a multitude of electric-lighting people—reputable business men engaged in large ventures—who believe with us that such an organization is a positive necessity.

In union there is strength, and in a broad and just policy, such as can be readily formulated where all interests are represented, every one may find a path leading to success, without wantonly infringing upon the domain of his neighbor, or trampling rough-shod upon his rights.

The National Electric Light Association is founded upon business principles, with a single eye to the benefit of all its members. Happily, its projectors have not fallen or been led into the errors that have characterized the inception of many another similar organization in other fields. There is no domination; no particular interests have been permitted to carry a subtle and mischievous influence in its councils.

It is not and will not be "run" in the interests of any clique; and no particular body of men, however rich or influential, can hope to use it to further unworthy ends.

The most insignificant projector will have a voice in its councils, be permitted to state his grievances, if he have any, with the assurance that they will be carefully inquired into, and the remedy diligently sought for.

There is room in the National Electric Light Association for everything in the electric lighting industry, save red-handed, law-defying, relentless monopoly.

It is founded upon the reasonable theory that there is room for all. In this broad land, where electrical projection cannot keep pace with the demand for the conveniences which it brings, it is manifestly absurd for the electric-lighting fraternity to engage in ruinous competition and strife

We have witnessed the by no means edifying spectacle of electric light companies engaged in hot contention for little or no profit, while vast extents of territory, still undeveloped, were patiently awaiting the coming of the projector.

On the one hand, we have a community in want of the light, and willing and abundantly able to pay a fair price for it; and, on the other, electrical companies forcing each other to take less than is offered for the service rendered. Seeing this, we are reminded of the railway companies which, though no living soul has protested that fares and freights were too high, nevertheless force each other to do business at a loss by inaugurating and continuing a senseless and ruinous competition.

It is the aim of the National Electric Light Association to stop this, or, since human nature possesses a certain amount of "cussedness," to reduce such unbusiness-like and bootless competition to a minimum.

In the mutual comparison of experience and methods, the association is doing another admirable work, and one which cannot but commend itself to every one engaged in electric lighting whose vision extends beyond the limits of his nose.

The last meeting of the association, which was held in New York city, attracted very general attention, both here and abroad, for the dignity and wisdom of its proceedings; and at the meeting, which will take place in Baltimore early next year, there is reason to believe that every legitimately-conducted electric-lighting company in the country will be represented.

GENERAL WESTERN NEWS.

Denver, Colorado, has been for a considerable period struggling with a proposition before the Council to adopt the Police and Telephone Company's system. The city had become a perfect paradise for thieves and sluggers, a condition of affairs for which there seemed no adequate prevention under the system in use. The city proper covers about 17 miles of territory, and the small police force, only 19 patrolmen, was entirely inadequate to cope with depredators of all varieties, with which the city was infested.

The matter had been once whistled down the wind by the Council, when the citizens took the matter in hand and petitioned the officials to adopt the measure. A re-consideration of the question was entertained at the meeting of the 5th inst., resulting in the acceptance, after some discussion, of the company's proposition.

So sanguine is the company of the retention of the system, once the installation is made, that the entire outfit of wires and instruments—everything but the horses and wagons—are furnished for six months on trial, and are to be removed at the end of that time, provided the working of the system is not perfectly satisfactory, without cost to the city.

The work of construction will be commenced within the next week, and pushed to completion at once. The plant will comprise a central station, several sub-stations, four wagons, and thirty street station-boxes.

Denver has also gone into the electric-light business, which, it is hoped, will further aid in scaring away the night-prowlers. The Board of Supervisors have closed a contract with the Colorado Electric Company, which will operate a system of both arc and incandescent lighting. 450 lamp posts—the entire number now used for gas-jets—are to be arranged for and supplied with incandescent lamps of not less than 20 candle-power to be run on the moon schedule, from twilight at night to morning twilight, save when the moonlight renders artificial light unnecessary. The contract price is $28 each, and for arc lights at the same proportionate rate per candle power. All arc lights are to be 2,000 candle-power, subject to photometric tests, whenever the question of standard light-power shall be in controversy, and a bond of $25,000, with sureties, is to be given by the company as a guarantee. Arc lights, within a prescribed district, are to be placed, if preferred by owners or occupants of the district, if the wish is expressed previous to the placing of the lights.

If the photometer does its duty impartially, and nothing breaks in the meantime, Denver's arc lights will be well worth looking at through colored spectacles, and her incandescent lights will gleam like a plank sidewalk on a frosty morning.

The Milwaukee muddle relative to light and underground measures is still town talk. In last week's REVIEW the matter of the Dorsett concession had progressed as far as the decision of the judiciary committee to recommend the substitute ordinance. At the Council meeting on the 9th the Badger ordinance was read *at*, the clerk complaining that it was almost impossible to make head or tail out of some of the provisions. A discussion followed the proposition to lay the matter over and have the ordinance printed. The president made some pretty sharp remarks and pointed intimations as to the change of front of one of the members who had so suddenly come to an about-face, and was rather personal, take it all in all. Among other remarks was one to the effect that if the Sperry wires were ever laid in Milwaukee it would be by the gas company. He did not believe the Sperry Company ever intended to lay any wires, and the gas company would have no objection to a company which would offer but little or no competition.

"Then up spoke the other man," and denied that he was acting in the interest of the gas company, or any other company; but as

the Sperry Company had offered to put all their wires under ground, and was ready to give a bond in the sum of $50,000 to fulfill its contract, he thought it only fair that the two ordinances should be considered together.

And another bold man, with a spirit of compromise in his heart, suggested that there might be an adjourned meeting one week hence, which would be so short a time that even the President of the Council might wait, and the President assented. The bill went over, and "again the racket" on Monday night. The Dorsett underground matter went over also.

The parties who were in Chicago, as chronicled by the writer, and who saw many lights, were considerably pestered on their return by friends who took no stock in what looked to the uninitiated as Munchausenish. There was no beer in the party, however, but there were two factions, one of whom favored the Sperry, the other the Thomson-Houston system. The latter was the light that particularly won the President's admiration, and this was the light which the Badger ordinance contemplated introducing. Now that Mr. Badger has become the Western representative of another company, some of the councilmen advocate a change in the title of the ordinance, and suggest substituting "Badger State" for "Badger" ordinance. There is a fair average of fun in store yet, before any one gets electric-light franchises in Milwaukee.

As there are two original, best and only applicants, it is not impossible that the houses may both be authorized to light the town. A member of the lobby, the other day, quoted Shakespeare when approached on the subject of systems. He said he was feeling much like Falstaff when Mrs. Quickly approached him "from the two parties, forsooth." "The devil take the one party, and his dam the other, and so they shall be both bestowed! I have suffered more for their sakes, more than the villainous inconstancy of man's disposition is able to bear." And added: "Why, here's Haskins, the city inspector, he can stand a good deal, but he came up to Milwaukee, spent one afternoon with the judiciary committee on this ordinance business, and in less than a week he was out at the County Insane Asylum!"

Our City Hall plant opened for business on the 9th, and the Common Council deliberated for the first time under the rays of electric light. The plant is an excellent one, and the whole is as neat and pretty as can be. It is a model piece of work.

There are about 1,200 lights of 16 candle-power in the building, fed by four dynamas, having a capacity for 1,600 lights. Two engines of the Armington & Sims pattern furnish the power, one of 100, and one of 125 horse-power.

At the meeting above alluded to, a memorial was received from business men and property owners, asking that they be heard before action was taken on the ordinance granting the underground conduit company authority to use space under the sidewalk for their wires. This memorial was referred to the fire and water committee.

Another central plant has just been put in operation, this time by the Schuyler Co. The engine and dynamos are situated in the basement of Armstrong's dry-goods establishment on State, between Madison and Monroe, and includes among its consumers dry-goods, glass-ware, fur, and millinery and other establishments. The wires are also run into a sewing-machine agency, and it is in prospect to utilize a portion of the current for motors to run a number of these machines. The light is giving very general satisfaction, and the company is already arranging for a third circuit to supply the increasing demand for illumination.

Our annual fat stock show, which opened on the 10th, is in full blast, with 50 Van Depoele lights, and will be continued until the 20th, when the exposition building will be again attacked by an intestinal disturbance, and arrangements completed for a skating rink, to run during the winter. This will also be illuminated by the Van Depoele system.

From present prospects there will be a large increase in the number of lights during the coming month for holiday purposes, in addition to permanent installations.

The Western Electric Co. is full of business with a long circuit on the West Side; the Hapgood folks are hard at work on the south side, while everything is being done to hurry up a large central plant on the west and one on the north side of the city. The United States Co. is hurrying up the county building's work, and the Edison people are to illuminate a bank building at an early day. Then, too, our tunnels are promised to be lighted within a week or so; so that, take it all in all, Chicago will make a pretty fair showing of lights of nearly every variety by the first of the incoming year.

"What do you think of this telephone suit, now?" was asked of an expert the other day, by a party who was drying himself after wading for two or three days through column upon column of manufactured opinion on the examination. The reply covered a deal of ground, and gave the whole affair quite a comical aspect. Said the gentleman, succinctly, "it reminds me of an old story which was told of a case in which a lady sued another for cracking a soap-kettle, and the attorney for the defence stated the points which he purposed proving by his witnesses:

"1. That the defendant never borrowed the kettle.

"2. That the plaintiff never had any kettle.

"3. That the kettle was cracked when it was borrowed; and lastly, that the kettle was whole when it was returned."

The claim here is that Bell stole the telephone from Gray by connivance with parties who had access to the secret archives of the Patent Office—*Ergo!* Bell must have his patent annulled. Gray invented it, but Reis preceded Gray; and, reasoning as before, the Paul for whom Peter was robbed must necessarily be robbed in turn, and the plaintiffs must have it, because they *didn't* invent it before Reis. If the plaintiffs prove all they can, according to their claim, then the dear public becomes the sole proprietor, and telephone systems will loom up as thick as slivers in a lumber yard. The monopoly must be taken from all, and given to none. We are going through another Drawbaugh experience, and in all human probability somebody will have the bag to hold after the little breeze blows over. The public seems to look on the present stir as a *bona fide* trial before some high tribunal, which is to settle the whole thing at once and forever. There is stock in the company of the complainants for sale, and the curious can gratify their longings in this matter who have "money that talks." It is at present higher than the Drawbaugh stock, and several other outside telephone stocks, but the faithful can buy an experience, should they so desire, at figures below par value, "if they have no abiding faith in a hereafter."

The new Norwegian correspondent of the REVIEW formerly of Minnesota, now resides in Chicago, and there is some talk of that gentleman's accepting a position as Consul at Christiania. His known ability as an electrician, together with his thorough knowledge of conduits and the most approved method of laying these, will render him a valuable advisory adjunct to the electrical department of that Government. Prof. Burdick will be followed, should he accept the position, by the best wishes of his ardent admirers, and his letters will be looked for with interest.

Col. S. G. Lynch, at 144 La Salle, furnishes the following quotations of telephone stock values:

Chicago	$375 @	$406
Central Union	50 @	53
Michigan	64 @	67
Iowa Union	18 @	20
Great Southern	30 @	32
Colorado	11 @	13
Rocky Mountain Bell	40 @	45
Mo. & Kas.	56 @	59
United	13 @	14
Cumberland	70 @	75
Wisconsin	110 @	112

CHICAGO, Nov. 18, 1885.

The Induction Problem.

Editors of the Electrical Review:

I desire to call your attention to a most valuable and important discovery in electrical telephony, being nothing less than the satisfactory solution of the much mooted but heretofore insurmountable problem of induction. The inventor is much troubled in deciding how to protect his interests in his valuable discovery. He fears to file an application for a patent lest some searcher in another field should get in a caveat on something else a few hours later in the same day. He dislikes to disturb the rest of some patient soul who might have invented the same thing many years ago, but who is now dead and gone. He also revolts with horror from the spectacle of the many misguided geniuses whose imaginations will speedily convince them that they are each and individually the sole and original inventor.

In a spirit of fairness to all, therefore, it is modestly desired to lay the facts before the public, with the request that if there be any sole and original inventor of this same device, he shall forthwith speak, or ever after hold his peace. Each "sole and original" as above noted is requested to name date of invention, etc., and give full particulars.

The oral testimony of deceased witnesses is particularly desired. Until the priority of invention is finally and satisfactorily determined in this manner, the inventor refrains from organizing a stock company. No donations of stock to government officials or others will be made until further notice.

Having thus mentioned the more important matters in relation to it, I beg now to call attention to the invention itself.

It is well known that when two long lines are suspended parallel to each other on one set of poles, and when two or more people are gathered together in telephonic communication on each of the said lines, there arises a most fearful confusion of tongues. There arises, also, at the ends of the several wires, the wrath of each party attempting to communicate.

The anathemas hurled at "the fellow on the other wire" are sometimes awful. This interference, under the general title of induction has baffled all efforts to suppress it. During one of the worst periods of this inductive clashing of wires, the inventor, happening to be in one of our leading telephone exchanges, was "looped into" one of the troublesome wires. The trouble was at its height. Jacob Spiegel, of Schleisingerville was endeavoring to tell Rosenheimer and Bedelbaum "dot dose close vas too schmall, ef dat udder feller yust vould shud up." It was no good, as John Jones, of Oshkosh, on the other line, was informing the New Era Manufacturing Company that "those buggy springs would have to be made 27x2½, if that d—d Dutchman would give him a show."

Suddenly a bright idea flashed through the mind of the inventor. Cutting in on the Schleisingerville line he exclaimed in loud tones: "Sprechen sie Deutsch?" "Ya Vohl," comes back the reply. "Then for heaven's sake talk Dutch," exclaimed our friend, and at once the great problem was solved.

The Germans conversed peacefully in German, discussing the various points in the clothing trade.

The Oshkosh and New Era parties were informed that, barring a low tension earth current, the other line was perfectly quiet. Repeated tests were made of this device, the only failure being the case of a man who was asked to pay a bill and who was totally unable to hear in any language.

The novelty and importance of this discovery will, at once, be apparent. The long expected induction-killer is a combination of English and German in equal parts. All rights are reserved as to future combinations but a mixture of Russian and Chinese is especially recommended.

I await with interest the claims of previous inventors and the endosement of capitalists. It has yet to be shown that this discovery may not be made the basis of a claim for the vacating of the Bell patent. In the words of an able correspondent of your journal, I will only add, that, "modesty forbids the mention of the inventor's name."

A. S. H.

Milwaukee, Wis., Nov. 15th, 1885.

The Electrical Subway Commissioners of New York visited Philadelphia and Washington last week to gather what information was obtainable in those cities that would aid them in their work of ordering all the wires underground in New York. They will soon visit Chicago and other cities where the wires are being experimented with under the surface of mother earth.

A company to be known as the Worcester Electric Power Company, has been organized at Worcester, Mass., Mr. S. E. Hartban is General Superintendent of the company. They purpose to introduce into Worcester the electric transmission of power for the operation of machinery for manufacturing purposes and also for the operation of street cars, and will at once petition the city government for the right to build and operate a line on Foster street, b tween Main street and Washington Square. This is placing the work at once on a practical basis, and good results cannot fail to follow.

Mr. J. J. Storrow, the distinguished attorney of the Bell Telephone Company, is in his present position, not only because of his eminent abilities, but more particularly because of his love for, and interest in, the telephone. A gentleman of means, never dependent on his profession for an income, he has entered the telephone business, and thoroughly mastered it, in both a scientific and legal sense, and is probably the best-informed gentleman in this line in the world. Quiet and unassuming, he never speaks on this subject before court or commission without receiving the closest attention.

There were several amusing things brought out at the Washington telephone hearing. In one case an attorney for the several petitioners stated that Mr. Tompkins, one of the bright attorneys of the Bell Company, at a certain conference had been given *twenty minutes* to leave the room, the gentlemen making the request standing with watches in hand to see that the stipulated time was observed. Perhaps the room was a large one, or perhaps the athletic build of Mr. Tompkins was taken into consideration; anyhow the time was ample for the leisurely departure of Mr. Tompkins, and, admitting for a moment that such a thing occurred, we have no doubt he took all the time he desired. It strikes us as extremely probable that Mr. Tompkins was invited to remain, and had he made the offer that was so much desired would, no doubt, have been a welcome guest at an elaborate dinner.

Mayor Grace Desires to Know Who is Responsible in the Underground Wire Matter.

The following letter has been sent by Mayor Grace to Mr. Lacombe, counsel to the corporation, regarding the Underground Wire Commission:

November 14, 1885.

Mr. E. Henry Lacombe, Counsel to the Corporation:

SIR,—I am instructed by the Mayor to ask your opinion on the following question:

Chapter 534 of the Laws of 1884 requires that every corporation, association, etc., owning or controlling telegraph, telephone, electric or other wires * * * shall before the first day of November, 1885, have the same removed from the surface of all streets or avenues in certain cities of this State.

Chapter 499 of the Laws of 1885, which supplement the act referred to, and which was passed on the 13th of June, 1885, authorizes and directs the appointment of commissioners in the cities referred to, who are charged with the duty of enforcing the provisions of the previous act.

Does the wide discretion vested in the commissioners by section four of the latter act, of deciding when and under what circumstances companies may retain the wires overhead; and does the fact that by section six, the term of office of the commissioners is made to expire on the first day of November, 1887, or sooner, upon the performance of their functions, indicate that the intention of the Legislature was to repeal, by implication, the provisions of the prior act, which directed, absolutely, that the wires be placed underground by the first day of November?

Respectfully,

WILLIAM L. TURNER,
Secretary.

Telephonic News

*** W. H. Lindsey, Brooklyn collector for the New York and New Jersey Telephone Company, is reported missing with some $2,000. The amount is fully covered by bondsmen.

*** The City Council of Galveston, Tex., in response to the request of the telephone and telegraph companies, has ordered the fire-alarm wires to be taken off of the poles of these companies, and new wires and poles erected for the use of the fire-alarm.

*** George J. Fryer, express and telephone agent, and postmaster at Glencoe, Ont., has absconded, taking with him between $6,000 and $7,000 left with him by banks to be expressed. He took a woman with him, leaving his wife in destitute circumstances. Fryer is evidently a bad man, but, as only one-third of this can be attributed to the telephone, the fraternity will try to bear it with complacency.

*** The Electrical Committee of Councils, of Philadelphia, is considering an ordinance authorizing the People's Telephone Company to erect their wires on and over the streets and roads of the city. A representative of the company stated that the company had no intention of running in opposition to any other similar corporation, but is intended to connect business establishments with residences.

*** There prevails an impression among capitalists, who have given some attention to money possibilities in telephones, that the Bell people do not expect always to defend their bonanza, so as to keep it a monopoly. Such capitalists profess to think that the shrewd financiers of the Bell Company are aware that telephoning will be declared some day as free to all as telegraphing, and that all that any company will do will be to protect its instrument by patent. Whether this is a correct opinion or not, it prevails, and to it is largely due the willingness of capitalists to look with favor upon any telephone scheme. Inventors now have little difficulty in getting moneyed men to examine and look into their telephone inventions, and there are some very superior ones in the market.

*** Mr. Sargeant, of the Brooklyn Telephone Company, has arranged for the new bond his company is to give to protect the city in the opening of the streets required to lay the underground wire system. He will apply for a permit and will begin to open the streets for the conduit. The conduit will be laid from the central office opposite City Hall down Fulton street to Main street first, and then from the central office up Fulton street to Raymond, and on Flatbush avenue to Third avenue. Ultimately a conduit will be laid on Main street, too, and that, and the one on Fulton street, will contain 400 wires each. It is to be remarked, however, that the poles will remain standing until the experiment with the underground system is shown to be a success. The company is now taking up some of the underground work of last year in the neighborhood of the Hall for repairs. The conduit is in good condition, but the cables are found defective in places.

*** The telephone was first tried in South Australia, with instruments of the Graham Bell type, made in the Government workshops, in Jan., 1878, between the Semaphore, Adelaide and Kapunda, and subsequently between the Semaphore and Port Augusta, a distance by wire of 240 miles. It was also tried most successfully on the Port Darwin line for a distance of 200 miles. The loud-speaking Gower telephones, which the South Australians made, worked admirably over long distances of line, and through great artificial resistances. Amongst many experimental trials of the telephones the colonists had several concerts, in which the singers and accompanying instrumentalists were eighty or more miles apart. On one occasion duets were sung, one person singing at Willanga with a pianoforte accompaniment, and the other at Kapunda, accompanied by a violin, the audience being in Adelaide. On the suggestion of the Postmaster-General, the Government established telephone exchanges, and it has the exclusive monopoly of the construction and management of all lines outside private property. The longest line is one of fifty-six miles, used by the Railway Department, and the same department has another of forty-five miles, with three stations in circuit. The first exchange was opened in May, 1883.

*** General Manager Metzgar, of the Central District Telephone, Pittsburgh, has introduced an Oram time repeater, by which it will be possible for any telephone subscriber to learn the exact time at any hour by placing the receiver of a telephone to his ear. Thus, if it is 1.35, one tap is heard, followed by three taps, then by five. If the time is 1.30, one tap, followed by three, is heard.

*** The telephone cases—that is, the prosecution of J. E. Hockett, district superintendent, under the Misdemeanor Act, for violating the State law regulating the rentals of telephones—came before Judge Norton, at Indianapolis, and by agreement a finding was entered against defendant, by which he was fined $5 and costs in two cases, and this was followed by an appeal to the Supreme Court. The trial was purely mechanical, the record being made up from the testimony in the civil suits before Judge Taylor.

*** A telephone, especially adapted for use in mines, has just been tested at the Warrior Run Colliery of A. J. Davis, in Pennsylvania. It is said to be different from the ordinary Bell telephone in that no electricity is used. It connects the engine-house of the colliery with the foot of the slope—a distance of about 1,700 feet. Despite the noise of the machinery and the rattle of the ascending and descending cars, conversation is reported to have been carried on without any trouble, and without any undue elevation of the voice. The words of the footman at the bottom of the slope could be heard as distinctly as though he were standing close at hand. The signal bell is similar to that on the Bell telephone.

*** The hearing in the telephone case now going on before Secretary Lamar, is attracting considerable attention, and each day the room is crowded with patent attorneys, electricians, inventors, speculators and distinguished gentlemen. The Globe Telephone Company, one of the petitioners, is represented by Mr. George Gantt, of Memphis; Mr. D. Humphreys, of Cincinnati, and Dr. S. R. Beckwith, all stubborn-looking men, with old time chin beards and bare upper lips. Col. Casey Young, of Tennessee, with a face as gaunt and withered as a picture of Cardinal Newman, and Mr. J. R. Beckwith, fat and fair, a distinguished lawyer of New Orleans. Professor Bell's leading counsel is Mr. J. J. Storrow, of Boston, a little dark whiskered man, very neat, precise and watchful. With him were associated Mr. Dickerson, a big, learned, gray-bearded lawyer from New York, and Chauncey Smith, of Boston, who sits all day at the end of the table silent and smiling. Mr. Smith's fair round figure, dressed in a large suit of glossy black, completely fills a big arm-chair. With his fat ruddy face, dimpled and clean-shaven, and bearing a benign expression, his long silvery hair falling upon his shoulders in ringlets, and his bright eyes peeping through gold spectacles, Mr. Chauncey Smith is the picture of Uncle Toby or the good old Vicar of Wakefield, and his presence makes everybody happy. Mr. W. W. Swan, of Boston; Mr. W. S. Nixon and other eminent counsel are numbered in Bell's legal combination. The Washington and Baltimore Telephone Company another petitioner against Bell's patent, is represented by Gen. Bradley T. Johnson, of Baltimore. Prof. Elisha Gray, the electrician, is also one of the spectators. Prof. Bell is in daily attendance, his bushy black hair, slightly tinged with grey, curled into a rising tuft over his expansive brow. The hearing by the Secretary of the Interior was a long one, the whole question being treated exhaustively.

... The Oberlin Telegraph College is in trouble. Some of the students have lately had their eyes opened to the fact that things are not what they expected. Five of the students have clubbed together, each depositing $25, and have secured the services of an attorney, with a view to recovering their tuition fees, and if possible bringing the proprietors of the college out in their proper light.

.... The train dispatcher is the autocrat, the sole ruler. No man dare dispute his authority. No man can move without his permission without endangering life and property and his own security. He is an important and indispensable official upon the railroad. He cares for the life and comfort and safety of every railroad traveler, and should not be forgotten as he toils day and night in the seclusion of his office in the interest and safety of those intrusted to his care.

.... The Board of Trade Telegraph Company filed a petition in the United States Circuit Court, at Chicago, setting forth that it leased to the Bankers and Merchants' Telegraph Company, February 1, 1884, its lines from Chicago to St. Louis, on condition that the latter make certain payments of mortgages and also a half-yearly rental. In default of said payments, the lease was to be surrendered. The Bankers and Merchants' Company, it is said, is insolvent and unable to pay, and the court is asked to order the receiver to surrender the leased lines. The court entered an order on the receiver to answer the petition in fifteen days.

.... A certificate of incorporation of the German-American Telegraphic Cable Company has been filed at Albany. The corporators and trustees named, who are residents of Boston and New York, are as follows: Henry Waterman, R. Philbrook, Benjamin F. Bradbury, George D. Rich, and Humphrey B. Wymans. The object of the company is to construct and operate a telegraphic cable from some suitable point at or near Boston to some point designated by the Emperor of Germany on the coast of that country; also a cable between Germany and Great Britain; also to lessen the expense in operating cables, as well as in receiving and transmitting messages from country to country. The capital stock is $12,000,000, which the company have the privilege of increasing to any sum sufficient to construct, land and operate the cables. The stock is to consist of 480,000 shares of $25 each. The principal business office is to be located in New York with a branch office in Boston. The offices are to be opened as soon as the sum of $2,000,000 shall be secured from the sale of 5 per cent. bonds issued by the company. The treasurer's office will be situated in Boston.

.... An Indianapolis correspondent writes: "There was mention, several months ago, that parties in the city had purchased "Toss" Seibert's patent automatic electrical system, in use in all fire-engine houses, and were preparing to collect royalty from all cities which had adopted the same. Afterward it developed that a man named Bragg had held a patent for a similar device, antedating Seibert's, and a consolidation of interests followed, but not until after weary negotiating and long delays. The upshot is, that a syndicate, headed by A. J. Trest and Frank B. Walker, hold what they consider a clean grip upon the device, and they are backed by two Federal Court decisions, one in a suit brought by Bragg against the city of Portland, Oregon, and the other, San Jose, Cal, on which royalties were awarded plaintiff on a basis of $100 for every one thousand inhabitants in the respective cities, and the defendants were forever enjoined from using the same unless by consent of the patentee. To-day the papers in this case were submitted for the inspection of the legal representatives of Indianapolis, prior to a formal demand for royalty, and a visit to Cincinnati on a similar errand will shortly be made. Every city springing open the stall-doors of its engine-houses and unloosening the horses by electricity are included, and the syndicate is firmly impressed with the belief that it holds a big thing financially.

The Telephone Hearing.

THE GREAT TELEPHONE WAR BEFORE SECRETARY LAMAR, AT WASHINGTON.

In the last issue of the REVIEW we gave an account of the telephone hearing before Secretary Lamar as far as it had progressed at that time. Since then the case has continued with increasing interest. At the conclusion of Meucci's affidavit, one from Prof. Elisha Gray was read. Prof. Gray begins his affidavit with the statement that in the year 1876 he conveyed a number of his patents, supposed, among other things, to relate to telephony, to the Harmonic Telegraph Company, in consideration of a stock interest in that company. Those patents were then conveyed to the American Speaking Telephone Company by the Harmonic Company for the consideration of one-third of the stock of the American Company. Mr. Gray says that the American Telephone, the Gold and Stock, the Harmonic and the Western Union Telegraph companies were the real defendants in the suit of the American Company known as the Dowd case. Some time after the institution of that suit, says Prof Gray, these companies combined in joint ownership of all the patents involved, the American Company receiving in the compromise 20 per cent. of the royalties received, and to share in the expenses of litigation and purchase of other patents. Before the combination was effected, and when it was understood that a compromise would be made, Prof. Gray says, he now believes that the litigation was not carried on in good faith with a view to a final settlement by the court. This, he says, resulted from the expectation of a compromise, and after it had been effected everything was done for the common benefit of the parties, and such decree as they desired was entered in the case. Prof. Gray had not control over this case at any time, he says, and his interest was represented by the combination in which he was interested. He filed a caveat for a telephone on February 14, 1876, and afterwards learned that Prof. Bell on the same day filed an application for an improvement in "multiple telegraphy." He learned, but not until after Bell's patent had been issued, that in it he claimed to have invented a telephone. Continuing, Prof. Gray says he is informed and believes that in a few days after the issuance of that patent Bell made an instrument with which he transmitted speech. Long afterward he learned that Bell first transmitted articulate speech through a liquid transmitter substantially as described in his (Gray's) caveat, and unlike anything described in Bell's application. For a long time he believed that Bell actually invented that instrument independently of his (Gray's) device. He did not suspect anything wrong, but supposed that in the eye of the law Bell had the advantage, as his counsel stated, and every oral statement and every letter coming from that affiant at that period was made or written under the belief that he had been fairly dealt with in the matter of the caveat. Recently, and long since the oral statements were made and the letters referred to were written, Prof. Gray says facts came to his knowledge that convinced him that he was wrong in assuming and believing that Prof. Bell had fairly made his invention. He now believed that Prof. Bell, on the contrary, had learned in some way of his caveat and the contents, and that he made use of that knowledge in constructing the instrument with which he first successfully transmitted articulate speech. He (Gray) had supposed that his discovery remained a secret in the Patent Office, as it should have done, and was not known to Mr. Bell. What he now stated on the subject was stated in view of information which satisfied him that Mr. Bell, having obtained his secrets, claimed his discovery as his own, and by this means got the credit of his (Gray's) inventions.

Acting, however, Prof. Gray says, under the belief of Mr. Bell's fairness in the matter, and under advice of counsel as to his rights, as before explained, he made such statements and gave such depositions as would seem to acknowledge Prof. Bell's invention. Being under this belief, he did not take steps to file

his application on his caveat promptly, but the matter rested without any application until November, 1877.

Speaking again of the Dowd case and the interference suits, Prof. Gray says: "It is not a fact that the result in the Dowd case was reached by a trial upon the merits, and a decision according to the merits, but it was reached by the agreement and understanding of the parties in interest. Nor is it a fact, as I believe, that the interference suits were carried on upon their merits in a real *bona fide* controversy; but, on the contrary, I believe that said interference litigation, although seemingly hostile, was really friendly, and the result reached was not a decision upon the merits in a hostile controversy, but in a collusive controversy in which the only parties interested were the parties in interest in the Dowd litigation."

Prof. Gray then goes on to explain the correspondence that passed between Prof. Bell and himself in 1877, in consonance with his present statements.

Mr. Young, attorney for the opposition, also read a letter from himself to the counsel of the Bell Company calling for the production of contracts alleged to have been made between the Bell Company and Elisha Gray, the Gold and Stock and Western Union companies, Blake, Berliner and others. In his letter, Mr. Young explained that he wished to establish by these contracts that the alleged telephone inventions of Bell were invalid; that the Dowd suit was inconclusive, and was only brought to obtain a judicial decree sustaining the patents; and that Bell and his associates entered into an unlawful combination to control all telephonic discoveries.

Mr. Storrow then opened the case for the Bell Company. He said that this proceeding was an effort to re-open the suit discontinued at Memphis. The affidavits read here were merely copies of affidavits used in former suits. Mr. Storrow summarized the voluminous evidence that had been taken in the suit pending in Baltimore brought by the Bell Company against the Washington Company. One affidavit—that made by Mr. Wilson, who was associated with Bell in his researches—described the public reception of the telephone as something unknown to mankind before that time. Bell's instruments exhibited at the Centennial Exposition were explained at length, and the assertion made that Gray was one of the persons who examined those instruments. In his testimony in the Dowd trial, Mr. Storrow said Gray stated that it was the first time in his life that he had ever listened at a telephonic receiver. Mr. Storrow, reading from the record of the Baltimore trial, took up the affidavit of Geo. Gifford, chief counsel for the Western Union Telegraph Company in the Dowd trial, wherein he admitted that the Western Union Telegraph Company acknowledged the validity of Bell's patent. Then he referred to the affidavits of Mr. Bell and his attorney, Bailey Pollock, as fully meeting the allegations of irregularities in the issue of the Bell patent. In answering Examiner Wilbur's affidavit, put in evidence by the petitioners, Mr. Storrow read from the record of the Baltimore trial a second affidavit made by Wilbur after the affidavit put in by the petitioners, and denying that there had been any collusion between himself and Prof. Bell. An affidavit by Lieut. Guy, of the District police, was presented to show that Wilbur had been arrested many times last August for intoxication, and on at least two occasions between the making of the two affidavits for the Memphis citizens.

An affidavit by ex-Commissioner of Patents Speare, wherein he declares that all of the proceedings attending the issue of the Bell patent were regular in form, was also read. Mr. Storrow also read a letter written by Prof. Bell to his parents from Salem, Mass., March 18, 1875, containing a report of the telephonic tests made by himself and Prof. Henry. He then wrote that Prof. Henry advised him to proceed and try to work out the idea himself. Prof. Bell explained that he did not have the necessary knowledge of electricity. Prof. Henry's answer was "Get it." He was encouraged and upheld in his tedious investigations by those words, and in one year secured his patent. Mr. Storrow read the complaint in the Dowd case, to show that it was a fair test of the merits of the claims of the different inventors.

Mr. Humpheys inquired if Dowd was not now in the employ of the Bell Company.

"No, sir!" emphatically replied Mr. Storrow, "he never was, and it is about time for that sort of talk to cease."

Mr. Storrow quoted from the evidence in the Dowd case the remark of the examiner to Prof. Bell when he notified him of the conflict between his application and Gray's caveat. "It is something along on that page the caveat interferes with," said the examiner. "Could there be a straighter statement that the matter in dispute was already in Prof. Bell's papers?" inquired Mr. Storrow. He then read a letter that was written by W. D. Baldwin, Gray's counsel, to Dr. White, Gray's partner, notifying him that Gray's caveat conflicted with Bell's application, and that as the application had been filed earlier in the day than the caveat, the Commissioner of Patents had decided that Bell's patent should issue. A second letter to Dr. White informed him that Bell was willing to compromise on the harmonic telegraph system. Gray replied that he would come to Washington.

Referring to Meucci's claim, Mr. Storrow said that it was old. It had been set out in full in a London scientific journal more than a year ago. It was asserted that he had a perfect telephone in 1864, but was so poor that he could not take out a patent. Why, one of his witnesses (Dendi) took out a joint patent two years ago with Meucci. Mr. Storrow read from the patent records a list of patents taken out by Meucci and assigned to other persons. The Globe Company had set up here that Meucci's claim had only lately come to their knowledge. It was on record that they had been assigned several of Meucci's patents as far back as 1883.

In answer to Mr. Eaton's affidavit, to the effect that he had been betrayed by his own counsel in the Spencer case, Mr. Storrow produced the record to show that his counsel (Mr. Baldwin) had used every effort to secure a decision in favor of his client, and had been seconded by Prof. Morton, who had failed to get audible speech transmitted through the Reis instruments. He also read from Judge Lowell's decision, where the Court declared that Prof. Dolbear's effort to transmit speech through the Reis instruments had resulted in a signal failure.

Referring to the Pittsburgh case, Mr. Storrow said it was brought by a branch of the National Improved Telephone Company of Louisiana, one of the promoters of this case. The Bell Company there got a preliminary injunction. Most of the evidence produced here in behalf of the Pan Electric and Meucci petitions consisted of simple sheets from the printed record used by the defence in the motion for a preliminary injunction, and found by the Court to be insufficient to defeat that motion. Therefore this case was, in fact, but an appeal from the decision of the Court.

Touching the affidavits made by experts to the effect that the Reis instruments had been operative in their hands, Mr. Storrow said they have introduced in those instruments the mechanical contrivances of Bell's instrument for the express purpose of producing the effect produced by Bell, and that they obtained those successful results, not by carrying out the effects aimed at and described by Reis, but by avoiding those very effects.

Referring to the demand made by the other side for the production of contracts alleged to have been made between the Bell Company and various other companies and individuals, Mr. Storrow said it was a little singular that they called upon him to produce a contract made by Gray with a company in which he (Gray) was one of the largest stockholders, and a contract made with Dolbear—that busy witness who could find time to collect affidavits from so many persons, yet could not find time to produce the contract that concerned himself. And so it was with Edison and others, said Mr. Storrow.

Secretary Lamar inquired if Mr. Storrow had those contracts. He replied that he had not, for he had not brought them from Boston. Some of the papers called for were already in the printed records of former suits, and he could produce the others.

Mr. Beckwith, counsel for the National Improved Telephone Company followed Mr. Storrow, and said that he was present during the Pittsburgh trial as a spectator only, but his recollection differed materially from the statement made by Mr. Storrow. In that trial Mr. Storrow made a full exposition of his case, but, before the defendants had an opportunity to reply, the Judge applied the judicial tourniquet, and said that on account of judicial courtesy, and the courtesy which should be observed between judges of different circuits, he would not consider the question of legality or construction of Bell's patent open for discussion on an application for a preliminary injunction; and that unless there was in the instrument used by the defendants something in construction that carried it out of similarity with the instruments proceeded against, then, for the purpose of a preliminary injunction, the matter was settled. As considerable importance was attached to that point by the other side, he presented affidavits tending to establish the facts as he remembered them.

Mr. Young inquired of Mr. Storrow if the Bell Company had not brought suit against the National Improved Telephone Company in New Orleans and against the Globe Company in New York, since the beginning of this hearing.

Mr. Storrow replied that the attorneys had been directed to bring the New Orleans suit long before the beginning of the present proceedings. In the case of the Globe Company it had been known for several years that such a company existed, but until within a very short time past they had never offered to use instruments or take any step that would admit of the beginning of a suit by the Bell Company. Within a few days, however, circulars issued by the Globe Company had been discovered that furnished the necessary evidence for the institution of a suit.

Mr. Young put in evidence affidavits of Prof. Waite and Prof. Paddock containing accounts of experiments made by them with the Reis and Bell telephones.

Mr. Humphreys read an affidavit by President Goodwin of the Globe Company testifying to Meucci's extreme poverty; that Meucci was oppressed by the American Bell Telephone Company through the institution of a suit against him, and that the Bell Company, through its attorney, had endeavored to purchase and acquire the claims of Meucci.

Mr. Storrow—"Who was that attorney?"

Mr. Humphreys—"We will point him out—you can name him."

Mr. Storrow—"Who is he?"

President Goodwin of the Globe Company rose and pointed to a gentleman in the room.

Mr. Storrow smiled, but did not offer to name the gentleman. Mr. Dickerson, however, said that the gentleman was a Mr. Tompkins.

Mr. Storrow then said that he had put in a sworn stenographic report of the Pittsburgh trial. In answer to the allegation that the Bell Company had attempted to buy Meucci's claims, he said that he could produce letters to show that the Bell Company had been invited to come to Philadelphia to negotiate with the Globe Company, and that they sent down a representative, but the Meucci people had declined to show him anything and he returned no wiser than he came.

Mr. Beckwith inquired if he would be permitted to put in a counter affidavit sworn to by five gentlemen, to the effect that no such invitation had been extended by the Globe Company; that the Bell representatives had called upon Mr. Goodwin and associates, and spoken of millions of money, and that the gentlemen representing the Globe Company had drawn their watches and given the Bell representatives twenty minutes to leave.

After some discussion between counsel the secretary decided to allow the Bell representatives two hours to prepare expert affidavits. The other side would be allowed sufficient time to reply. He begged the petitioners to condense their arguments into as short a time as was consistent with a proper presentation of their case.

When the hearing was resumed Saturday morning, Mr. Storrow submitted a number of affidavits for the Bell Company. One of the affidavits was made by Mr. Frank Pope, denying the similarity between the models submitted and the original Reis instrument. He next read copies of letters passing between Mr. Gray and his counsel, Mr. Baldwin, in November, 1876. Mr. Storrow said that Mr. Baldwin was suffering from a cruel imputation, and it was but fair to read this correspondence to vindicate his conduct in connection with an affidavit by Mr. Baldwin bearing upon the same matter. The correspondence, said Mr. Storrow, showed that the brief filed in an interference case by Mr. Baldwin had been filed with Mr. Gray's full consent and approval, and after having been shown to him beforehand. It would also show that the alleged improper concession and compromise had been made with Mr. Gray's approval, after having been thoroughly convinced by the proceedings in the Dowd case that Bell's claim was superior to his own. Mr Storrow also produced a number of the contracts called for by the other side. An affidavit was submitted by Mr. William C. Tompkins in answer to the statement made the day before to the effect that he had endeavored to purchase the Meucci claims for the Bell Company. He declares that he was invited to go to Philadelphia by Mr. Willoughby to examine the Meucci claims; that he did so, and that the gentlemen representing that interest refused to confer without an express understanding that the Bell Company would purchase their interest. He had refused to enter into any such agreement, and that was the end of the transaction; no offer of money was made by him or even referred to.

Secretary Lamar announced that he had decided to allow each side five hours in which to make their argument. The hearing would be continued until 10 or 11 o'clock that night, and run over perhaps two hours into Monday morning. There were one or two points on which he would invoke some discussion at as early a stage in the arguments as they could be brought forward. He would like to have some definition of what constituted an invention, which had the effect of anticipation—that is, an effect to preclude third parties from getting a patent. After the question of power was settled, he would like a well-formulated theory of what constituted a good cause for the cancellation of a patent that had been issued by the Government. In other words, supposing the question of power to be out of the way, and assuming the existence of that power, what circumstances would warrant the Government, in the exercise of its sovereign power, recalling a franchise which it had once constitutionally granted?

Mr. Humphrey, for the Globe Company, then opened the argument. He quoted the decision of the Supreme Court in the Lock case (18 Wallace) as defining the rights of an inventor. Referring to Wilbur's testimony, Mr. Humphrey said that Wilbur was more sinned against than sinning. He said everything that Prof. Bell had to-day he owed to Wilbur, and to spurn him from the door when he respectfully asked an audience, after all he had done for him, was perhaps without a parallel. Mr. Humphrey turned his attention to the testimony bearing upon the filing of Bell's application. He declared that Bell had acquired and utilized the knowledge of Gray's caveat to amend his application. Bell went home to Boston on February 25. On the 26th his application passed the Patent Office, and on March 1 he produced the first speaking telephone he ever talked over, and he used a liquid transmitter—Gray's invention. The question as to the illegality of the method by which Prof. Bell gained and utilized the knowledge of Gray's caveat had never yet been tested in a court, and that test was the object of the present effort. Prof. Eaton's testimony showed that he improved the Reis tele-

phone and talked frequently with Mr. Prat through the instruments in the summer of 1875, the year before Bell filed his application. These facts they wished to prove in court. The Bell Company relied upon the Spencer case to disprove Prof. Eaton's claims, but Eaton had refused to testify there because the establishment of his priority of invention would throw the telephone open to the world.

Referring to Prof. Dolbear's case, Mr. Humphrey said that he had produced a magneto-telephone in September, 1876. He exhibited it to Mr. Richards, and he told his friend, Prof. Bell, what Prof. Dolbear had done. Dolbear was informed that Bell had invented the same thing two years before, and he thereupon dropped his investigations Meanwhile Prof. Bell and Gardiner Hubbard rushed down to Washington, and in January, 1877, took out a patent for a magneto-telephone. He defied Prof. Bell to bring a single university or scientific institution to sustain his claim that he was the inventor of the telephone.

Mr. Humphrey charged boldly that in the interference case before the Patent Office every one of the persons there represented was purchased by the Bell Company; every one of the counsel, including Mr. Baldwin, a highly respectable gentleman, counsel for Prof. Gray, he said was paid by the Bell Company, and every sentence of that voluminous record was paid for by the same company. In conclusion, Mr. Humphrey appealed for an order to institute the suit prayed for, an order to go to the very bottom of all claims, and mete out exact justice to all persons.

Mr. Beckwith followed for the Globe Company, in support of the claims of Antonio Meucci. He said the Government had been petitioned in vain to inquire into Meucci's claim. If they could establish the fact that Meucci invented and used a speaking telephone, that would dispose of the claims of Bell and all other inventors. Meucci was a graduate of the University of Florence, and spent six years there in the study of electricity. Mr. Beckwith comdread the researches of Bell and Meucci. Bell, he said, took out a patent in 1876, and did not mention the word telephone. He had no conception of its use as a speech transmitter until he heard of Gray's invention. Three men tell us that as far back as 1849 Meucci used a speaking telegraph to transmit the human voice, and in 1869 he invented a perfect telephone. Mr. Beckwith exhibited Meucci's models, and taking up the reproduction of his telephone made in 1860, declared that it contained the essential parts of a perfect telephone. This old man Meucci, said Mr. Beckwith, 73 years of age, had been chased up within the last three days by the Sheriff, set on by this unearthly monopoly, chased across the bay to Staten Island to his home. Could they get justice in New York? He had invented the telephone that they had used. In the name of justice, of science and of fair dealing he appealed to the Secretary to grant them something, so that the old inventor might rest in peace, and the hounds of the Bell Company might keep their hands out of his gray hair.

Mr. Beckwith rapidly reviewed the testimony showing the practicability of Meucci's telephone, and said that a mistake had been made in his caveat. He never intended to insulate the persons speaking, only the wires. He declared that in Meucci's note book could be found a perfect drawing of a telephone. Mr. Beckwith alleged that from the beginning of the telephone business down to the present day, there had been a great deal of irregularity—there had been a great deal of lying, and professional swearers were kept by the wholesale. But he hoped that this old man would be allowed to go unscathed; that he would be allowed by the Government to defend and protect himself.

Mr. Young, for the petitioners, then laid down the following propositions: That the Government has the power and legal authority to file this bill in any one of its own judicial tribunals having jurisdiction in such matters, to recall and declare void a patent; that it had the power inherently and independently of any express statute; that whenever it is shown to the proper officers of the Government by citizens that a patent has been fraudulently issued, that power should be exercised; that the evidence of the record in this case shows such a state of facts as would warrant the Government in exercising that power; that there are abundant precedents in the history of the Government for such action. He said that the Bell patent is invalid, for the reason that it is too broad in its terms, and is violative of the principle of law that underlies the whole patent system, by giving the patentee the control, not of a process, but of an element of nature—a current of electricity. It was void for want of utility. It had never yet spoken into a human ear a single word. It was voidable because in its progress through the Patent Office there were such irregularities, such a disregard for the law, as to divest it of the sanctity that otherwise attached to the issue of a patent.

Mr. Young cited at length the barbed wire case and others as precedents where the Government had gone into court to test patents in the face of numerous judicial decisions upholding those patents. "Why were the other side so alarmed?" inquired Mr. Young, "now when it was proposed to proceed against them through the Government? They had already triumphed in eighteen suits and expressed themselves as secure in their rights. Was it not clear that the legal mind of the country as well as the public mind was not satisfied with the correctness of former decisions?

At the close of Mr. Young's argument Mr. Gantt presented a long list of authorities relied upon by the petitioners to support their motion.

Mr. Storrow then began his reply. He explained at length the matter of the law to which the Secretary had directed the attention of counsel—that is, the definition of an invention that anticipates the inventions of third persons. In regard to prior publication, he maintained that the law required the publication to so describe the device that it could be constructed and operated without assistance from the matter disclosed by the patent. He quoted at length from the sewing-machine case to sustain his argument. It it were established, said Mr. Storrow, that Prof. Bell furnished the telephone to the world and a flaw were discovered in his patent, then it was the duty of the Government to perfect that patent. He read from the report of Prof. Henry at the Centennial Exposition to substantiate Prof. Bell's claim to the invention. He inquired if the Commissioners were ready to pick flaws in the patent which this man Bell had earned; to attack this patent because of misconduct alleged to have occurred on the part of one of the officers of the department, which he denied. Mr. Storrow turned his attention to the matter of right of the Government to bring suit to revoke a patent. He said that there was no necessity for the United States to bring this suit—no remedy that could not be obtained by an individual. A decree favorable to the Bell Company, obtained at Memphis, would bind no one because it was brought by the people, all of them. His opponents were in the position of men lying in wait behind a wall to shoot a man who passed unarmed. A decree against the Bell Company would end them, a decree in their favor would be of no service to it, and would bind no one. Was it the intention to bind the Bell Company to refrain from prosecuting injunctions in other cases until the long litigation in the United States courts had dragged itself along to a close? He suspected that was an object sought, and although he had his own views about the ability of his opponents to do so, yet he would point out the dangerous weapon they sought to control through the results of this proceeding.

"Adopting the most extreme view of the case yet suggested," said Mr. Storrow, "that there was a fraud in the Patent Office—that Prof. Bell had bribed a Commissioner or committed perjury—what does the United States propose to do? Send him to the penitentiary? No; they propose to confiscate his property. Why? Well, because somebody wants it."

Mr. Storrow gave a sketch of the Pan Electric Company. It originated among a few gentlemen in Congress in 1883, he said, when the Bell patent was seven years old. They acquired certain patents of one Rodgers amounting to no more than a few trivial changes in form of the then existing instruments. To sell stock they saw the necessity of guaranteeing protection from litigation, and they organized a number of branch companies. In the Pittsburgh case, Mr. Storrow said, the Pan Electric had deserted its offspring, the Western Pennsylvania Company, and the defence had been abandoned.

As to the charge that information had been given to Mr. Bell as to the contents of Prof. Gray's caveat, "Was it fraud on Mr. Bell's part," inquired Mr. Storrow, "because the examiner or commissioner had made a mistake, supposing that a mistake had been made?" But there had been no mistake. In point of fact Mr. Bell did not get any information beyond the statement that a caveat had been filed conflicting with certain specified claims in his application. Under the rules of practice at that time he was entitled to that information.

Mr. Storrow produced the patent, and declared that not one word of the claims relating to the speaking telephone had been amended; it stood exactly as sworn to by Prof. Bell three weeks before filing, at Boston.

The hearing in the telephone case was resumed Monday morning of this week. Prof. Gray read an answer to the affidavit of Mr. Baldwin, his former counsel, read on Saturday. He said it seemed proper for him (Prof. Gray) to explain his apparent inaction in regard to his caveat as shown in the correspondence submitted by Mr. Baldwin. He declared that he had had the fullest confidence in his counsel's integrity and ability, and had acted entirely upon his advice in refraining from contesting Bell's application. It appeared now that he was mistaken. Mr. Gray quoted from his former affidavit the statements touching his connection with the Harmonic Company as sufficient reason for his lack of interest in the issue of the telephonic patent. Again he declared that Bell's invention, as set out in his specifications, was inoperative and that no one, in the condition of electrical science at that day, could have made the instrument speak. He had never fully appreciated the position into which he had been drawn until lately, when certain facts had come to his knowledge that opened his eyes.

Mr. Beckwith, of the New Orleans Company, then began his argument. He inquired of Mr. Storrow how many telephones of the kind described in the Bell patent of 1876 had been sold and were in public use.

Mr. Storrow—"About 300,000, I believe your clients say."

Mr. Beckwith said he did not refer to the instrument on the walls of the room, but to those described in the Bell patent. It was only fair that the Bell Company should be held to as nice a reproduction of Bell's original instrument as it was insisted the petitioners must furnish of the Reis instrument. Mr. Beckwith, continuing, took up the points of law involved in the case, and proceeded to answer Mr. Storrow's argument. He then turned to Prof. Bell's claims, and characterized as bosh and nonsense his theory of undulatory vibrations of the electric current. That soul of hypothesis, said Mr. Beckwith, would be found at some distant day entombed in dark cabinets as a curious relic of a bronze age. But if that undulatory current existed, it had been launched by the hand of the Almighty at the birth of creation, and capable ever since of conveying speech. How on earth could there be any invention in that? He reviewed the evidence bearing upon the issuance of Bell's patent, and asserted that the circumstances all warranted and demanded a judicial investigation.

Mr. Dickerson then took up the argument for the Bell Company. He would answer a question put this morning by the statement that there were more than 30,000 magneto-telephones in use two years before the variable resistance telephone was put in use. These men (the petitioners) had told us, said Mr. Dickerson, that Prof. Henry and the Centennial Board were fools and dolts because they had said that Bell's invention was the greatest marvel ever achieved in the electric art. It was of a piece with their statement that a certain judge had displayed unparalleled effrontery in deciding that Bell's invention was new after Reis'. Mr. Dickerson took up the alleged reproductions of the Reis instrument and pointed out the dissimilarity between the original drawing and the reproductions. And this Citizen Van Benthuysen, said Mr. Dickerson, who did the miscellaneous business and every variety of swearing, said the instruments were *facsimiles* of the originals. Taking up the petitions, Mr. Dickerson said that McDonough was an enjoined infringer; Van Benthuysen was enjoined through his company in the Pittsburgh suit; the Washington company was under a restraining order and would be enjoined; and Meuccie, that grand old man, with a company representing $10,000,000 (the Globe Company), out of which they could not squeeze enough to keep him out of the poor-house. Against these men were arrayed Prof. Bell with a reputation second to none, the Justices of the Supreme Court, three Circuit Judges, and three or four District Judges, who had all passed upon these cases after litigation lasting for seven years.

Mr. Dickerson having attacked the Pan Electric Company. Mr. Gantt said that that company was not there.

We have been seeking that company industriously for some time, said Mr. Dickerson, and we will reach them yet. He reviewed the proceedings leading up to this action. A meeting of citizens was held in Washington, said he, the citizens being the Pan Electric Company and Citizen Van Benthuysen. That meeting went to the Attorney-General and asked to file a bill at Memphis that would show those five or six circuits what the law was. Of course, the Attorney-General had turned them out, because he was an owner of the stock, but they renewed their enterprise, and got Solicitor-General Goode to direct the Memphis suit. That was so outrageously bad, however, that it had to be withdrawn. Mr. Dickerson then went on to argue that the petitioners might get speedy trials without this proceeding.

Mr. Dickerson, referring to Mr. Gray's caveat, said that it was charged that Prof. Bell had stolen from the Patent Office information known to the world for fifteen years before. Then he corruptly stole a caveat, and yet he did not put its contents into his patent—it was not there. Was Prof. Bell to use the words of James Watt, when he, under similar circumstances, wrote: "They assail my honor that they may rob me of my profits?" Mr. Gray had always said—had sworn—that he had no chance; and yet to day, after an honorable career—God knows what the temptation is, said Mr. Dickerson—after all he has written, he comes here to slur, to vilify, and cast suspicion and contempt upon, and destroy the fair fame of, that eminent man, whose honor and glory he envies, and of which he is jealous. In conclusion, said Mr. Dickerson, the man who did too much for his country had met a real misfortune, because it excited against him the envy of the base, the jealousy of the ignoble, the cupidity of the avaricious, and the hounds hovered about him like wolves about the sheepfold, to rob him of his honor only that they might steal the profits.

Mr. Gantt followed for the petitioners with an argument directed mainly to the legal aspect of the case, and a discussion of the force of the numerous authorities. He declared that it only remained for giant monopolies to raise such questions of jurisdiction as had been raised in this case; monopolies of $100,000,000 might attempt to raise questions that the citizen of the Republic takes for granted. "Take the 300,000 telephones admitted by the counsel," said the speaker.

"I did not say so," interposed Mr. Dickerson.

"Well, I say so," continued Mr. Gantt. "At $25 per year they will return $7,500,000 per year—a fair percentage on $100,000,000." Touching the Pan Electric Company, Mr. Gantt said he desired to say a word for it. Included in that company were his friends Senator Harris and Mr. Young, and connected with it had been Attorney General Garland and Gen. Johnston. Those men had never been charged with greed; whatever else they had done, they had lived to the present time with reputations unstained and unsmirched. "There is a storm in the land," said Mr. Gantt, "that will shake this monopoly. This inquiry cannot be suppressed; there is no power to suppress it; there is enough of influence to demand triumphantly the investigation, and it must come." It has been said that Prof. Gray had lost his caveat because of his neglect. If he did not show Bell in the company of the man that deceived and finally misled Gray as to his invention, then, said Mr. Gantt, he would yield this case; and if he were in company with that man, why was it? He then read from the evidence touching Gray's caveat, and the correspondence between Prof. Gray and his counsel. "But we have got them," he declared; "we have got them by a cable of their own weaving. We have driven it into the hide of this rhinoceros monopoly, and mean to hold it And more than that, if we can stand before a court and jury, we can demonstrate that there is rottenness, fraud and collusion at the bottom of this transaction."

A recess was taken to 8 P. M.

At 8 o'clock Mr. Gantt continued his argument. He said it had been shown that Bell and Baldwin (Gray's counsel) were together on the fatal 3d of March; that Baldwin had written on that day to Dr. White, Gray's partner, advising him against the prosecution of Gray's claim. It had been shown that Baldwin admitted Gray's priority, in direct contradiction of the fact that he advised him against prosecuting his claim. "Who put Gray to sleep?" inquired Mr. Gantt. "Who lulled him into supineness?" This very counsel who makes this record. It festered in its filth; it was in the record, and a good deal of it the learned counsel on the other side put in evidence. Where did Baldwin draw his rations and who buttered his bread when he made those two speeches? It was this monopoly; it was in the record, and to-night, exclaimed Mr Gantt, he would take judgment against this monopoly as a confessed fact. He was delighted when the other side put in the testimony touching Wilbur's bad character. Now they would not touch him; the police had locked him up. Then they were close with Wilbur; he was "my dear Wilbur." No need to say he was a weak man, a leaky vessel. So much the easier to draw the water. They sampled him as a cotton broker tests a cotton bale. They thrust in a hook and dragged out the cotton and knew what was in the bale. He would prove that Bell in his amendment changed his specification by substituting for the words "intermittent" and "pulsatory" currents apt words that changed them to undulatory currents. He made the change without oath, and after seeing the caveat of Gray providing for gradually increasing and diminishing the currents. Mr. Gantt read from the record, evidence to sustain his assertions. Resuming, he said that if Bell made that change without oath it destroyed his patent. It showed a looseness in favor of of Bell, a freedom allowed, a favoritism in the Patent Office, which would destroy his title to his property. After wrestling day and night in agony to bring forth his great invention, what did Bell call it? Multiple telegraph—not telephone. They left out of the specification the word "quality." Fatal omission! The human voice could be transmitted only through its quality. Amplitude and pitch were not enough. This claim was malformed—it was an abortion. Without a name; with a body and no head; the crown was wanting Gray named his; he described what he would do and how he would do it—he would transmit speech. He asked if Bell had advanced further on the 10th of May, 1876, weeks after the issue of his patent, than Reis had advanced when he died, in 1874, and read in answer statements alleged to have been made by Reiss and Bell to show that both of them acknowledged the imperfections of their instruments and relied upon mechanical improvements to perfect their operation. The gentlemen had admitted that the Reis transmitter would transmit speech. Then their whole case was gone. They had not proved that the original Bell instruments would operate; the evidence was against them on that point.

Mr. Gantt took up the affidavits submitted by the experts for both sides, and maintained that his models corresponded with the originals described by Reiss. In concluding he said: "Only allow us opportunity in a fair field, where no jockey races will be run, and we will demonstrate the fact that this monopoly ought to be overthrown."

Mr. Storrow was granted permission to answer a few authorities introduced by Mr. Gantt, and explained the conduct of the interference proceedings. This concluded the arguments, and with the announcement that briefs might be filed with n ten days the hearing in this famous telephone case was declared adjourned.

The New York Subway Commision.

Its Investigations in Philadelphia and Washington.

Having had a great number of plans and systems submitted for its approval, the New York Subway Commission determined to visit Philadelphia and Washington to see for itself what had been done in those cities in the way of underground work. It should be remembered that the law makes it its duty to either find or devise, or cause to be devised, a conduit system into which the wires of the several electrical companies may be put, and that it is only incidentally that it looks into and considers the various plans proposed for obviating induction, retardation, and all other ills that electrical conductors are heir to. And it should also be said that it is a legitimate interpretation of the law creating the Commission to say that it contemplates an inclusive conduit, one in which all manner of wires may be carried, for it would clearly be out of the question to permit each electrical company to have its own subway. There is not room in the streets for such an arrangement, and if there were, with a dozen or more conduits in each street, travel would be continually impeded by openings made for one purpose or another.

Commissioners Loew and Hess went to Philadelphia on Friday of last week, Commissioner Moss being detained in New York. They were first shown what Mr. David Brooks has done in that city. He has a Brooks cable extended from the lower part of the city to Kensington, a distance of about two and one-half miles. The conductors are all small, and are designed for telegraphic or telephonic purposes. The cable, as usual in the Brooks system, is contained in an iron pipe, and the insulation is maintained by keeping the pipe full of oil under pressure. This cable was put in by Mr. Brooks, and is used for experimental purposes. When a complete metallic circuit was used, the talk over the telephone was clear and distinct; over a single wire, with a ground at either end, it was less satisfactory, although still fairly good. The Commission learned from Mr. Bentley, President of the Philadelphia Telephone Company, that he had offered to test the cable thoroughly if Mr. Brooks would place a number of the conductors at his disposal for a short time for that purpose, but that Mr. Brooks had declined. They also learned from Mr. Brooks that he had offered to furnish the Philadelphia Bell Telephone Company with its entire wire service underground, provided the company would pay him annually one-half of the amount received from its subscribers. It need hardly be said that this offer was not accepted.

To those who accompanied the expedition it did not seem that the Brooks system even claimed to be what the Commissioners were seeking.

Radically different was the system of the Sectional Underground Conduit Company, whose work was next examined. This *does* claim to be an inclusive system, capable of carrying all kinds of wires without interference, the one with the other. It consists of a cast-iron conduit of rectangular cross sections, made in sections, and so laid as to break joints, moisture being excluded by luting the joints with plumbers' putty. Within are sections upon which rest dividing partitions of iron plates, so that the conduit is cut up into a number of separate ducts. At the street corners are man-holes, and in front of each house there is a hand-hole, easily reached by taking out a few paving stones, digging a foot or two, and reaching the hand-hole cover. The man-hole covers are flush with the street. The company owning this system has shown the courage of its convictions by constructing something over a mile of this conduit, distributed as follows: On Chestnut, from Third to Broad, which is eleven squares; on Broad, from Chestnut to the new City Building, about one square, and short distances on Tenth and Eleventh streets. Into this are drawn some six or eight electric-light wires, which do not, however, extend below Seventh street. These are No. 4 copper wires, insulated, and separately lead-covered. These lie on the bottom of the conduit, and are separated from the upper portion by the iron plates referred to. In the upper portion are two separate small wires, insulated, and separately covered with lead, which are used for telegraphic and telephonic experiments. It will be observed that not only is each individual wire shielded from every other by lead covering, but that the electric-light wires are additionally shielded by being placed in a duct by themselves. From this conduit arc lights are furnished along Chestnut street, both for street and for commercial use without overhead connection; and, while the arc current was on, conversation was carried on by telephone without interference. So far as the ear could detect, there was practically no induction, and there were no evidences of retardation, although the line was hardly long enough to warrant one in looking for it. So far as the electric light is concerned, the system may be said to be in commercial use to a limited extent, but in other respects it has not passed the experimental stage. The evidence would seem to indicate, however, that if each telephone wire were separately shielded with lead—that is, entirely coated with it—difficulties from induction would be guarded against. What retarding effects this might have over long distances, it is not difficult to imagine. This conduit has now been down nearly two years, and, with one notable exception, has given but little trouble. And this trouble was not only unlooked for, but difficult to guard against. Owing to leakage from the gas mains, the ground is full of gas. In some way this found its way into the conduit, and, owing to sparking somewhere, the cause of which has not been accurately determined, a series of explosions ensued. The man-hole covers went flying into the air, the conduit was more or less shattered, and a renewal of a considerable portion became necessary. To obviate any recurrence of this, an air pump was set up in the electric light station, and a blast of air, under light pressure, is kept moving through the conduit, driving out the gas at the lower end, to the no small annoyance of the Third street brokers, who object to breathing it, but this latter annoyance will easily be overcome by the use of a pipe carried above the house tops. This same blast of air serves an excellent purpose also in keeping the conduit dry and preventing rust. Of course, it adds to the expense, and this, in the case of a complicated system of such conduits, crossing each other at right angles, and covering a large area, would be very largely increased, besides presenting a somewhat novel and difficult problem in ventilation.

As yet the telephone company has no underground work in Philadelphia, nor has the Western Union, although it is preparing to put down some bored cypress logs, into which cables will be drawn.

In Fairmount Park the Commission was shown an underground connection between a pumping station and another building a mile away. It is a Waring cable of two conductors, buried in the earth. Talk was carried on by telephone over this line and was exceedingly successful, the ticking of a watch being distinctly heard. In this case the two wires in the cable were used as a loop, but the circuit was not metallic. There was no induction, and indeed there was no cause for any, there being no other electric wires in the vicinity. No retardation was perceptible.

This practically covers what the Commission saw in Philadelphia.

In Washington, on Monday, the Commission was first shown the underground work which has been done by the Government to connect the Capitol with the several departments. The Waring cable is used, and excellent results have been obtained in the main. In conversing between the War Department and the White House the talk was clear, distinct and sharp. The same was noticed in talking from the Fire Department headquarters to a station half a mile away, but in talking from the same place to the Insane Hospital, over a line which was in part a Waring cable, in part overhead and in part aerial the talk was excellent.

The telephone company in Washington has done a considerable amount of work in Washington. It has in all about three and one-half miles of underground construction. This contains 1000 miles of wire in all. The Patterson cable is chiefly used, although here is one Phillips cable nearly a mile long, containing fifty conductors. These cablest extend to the immediate vicinity of the places where the wires are to be used, and here the wires are distributed overhead from a pole. There are no underground house connections.

The Western Union company has put in a considerable length of bored cypress logs, but no wires have been drawn in, owing to some legal trouble. The Baltimore and Ohio is using some Waring cable with success, and the Averill company is constructing for its use a short section of Averill conduit on trial, but it is not finished. The postal company has two wires working through a paper-tube conduit, and this is about all that has been done.

In both Philadelphia and Washington every opportunity was given the Commissioners to see everything that has been done, and every facility for testing the lines was placed at their disposal. What conclusions the Commissioners may have reached as the result of their trip is not known, but it was the feeling of the gentlemen who accompanied them as a sort of volunteer non-commissioned staff that while much had been seen that was interesting and important, the long sought inclusive system has not yet been discovered.

—— The question of electric lighting is being agitated by the people of Hannibal, Mo. S. F. Roderic is mayor.

—— At Binghamton, Mass., where the Brush-Swan Company are installing a fine electric-light plant, the belting of Laurence & Herkner, of this city, has been adopted.

—— An electric light plant of the United States Company's system, has been installed at Moberly, Mo., and consists of sixty arc lamps. Mr. J. R. Simpson, of that city, who is interested in the local company, writes us that the "lamps are burning beautifully."

—— Had the REVIEW cared more for a little paltry advertising, than it did for its independence, it would not have criticised the greediness of the Edison Company. That company will always get justice at our hands (and it has associated with it some very capable and estimable gentlemen who are stanch friends of this journal), but when it presents the absurd claim to a monopoly of the incandescent field it becomes a fit object of ridicule.

—— The Diehl Electric Motor, controlled by the Electrical Supply Company of this city, meeting with extensive sale, and is quite a successful motor for running small machinery, such as sewing machines, fans, dental apparatus, etc. The electromotive force required for motor No. 1, is from 5 to 8 volts (not ⅔ as recently stated), and for No. 2, from 9 to 15 volts. Mr. Philip Diehl, the inventor, is a resident of Elizabeth, N. J.

—— At the meeting of the Brooklyn Bridge Trustees, November 10th, the president announced that pursuant to the authority conferred by the board on October 12, he had obtained the following bids for the new 10-light dynamo and other additions to the electric light plant: Brooklyn Electric Construction Company, $1,250; U. S. Electric Lighting Company, $1,325; Schuyler Electric Light Company, $1,350; Mather Electric Company, $1,442; Citizens' Electric Illuminating Company, $1,474; American Electric Manufacturing Company, $1,621; and that acting upon the recommendation of the chief engineer and superintendent he awarded the contract to the U. S. Electric Lighting Company.

—— The Consolidated Electric Light Company (owning the Sawyer-Man patents), have met with good success since opening their office in Boston. This company have put in a 150-light plant in the Cobarmett Mills, Taunton; another of the same size at the Woven Hose Company's factory at Cambridgeport, and have just received the contract to install a 100-light plant in the building of the N. E. Telegraph and Telephone Company, Pearl street, Boston. The latter contract they obtained entirely on the merit of their apparatus, the general manager of the telephone company having looked at the different systems in use in New York City, and decided in favor of the Sawyer-Man, a system giving universal satisfaction.

—— The appropriation for the city electrical department of Philadelphia for 1885 was $84 407. The sum asked for 1886 is $149,200, an increase of $64,793. There are two main items on which the increase is asked. One is for $30,000 for additional electric-light lamps, and the other is for $30,000 for putting the city wires underground. The electric lamps already in use cost the city $30,000 a year, or an average of $182 a lamp. These items were passed by the committee, although several members declared that they did not believe that any practical invention for the successful operation of wires underground had been discovered. The other items asked for in the increase are for a manager's assistant, at a salary of $800; two operators at the Fire Department headquarters, at a salary of $750 each; and one additional operator at police headquarters for work in connection with the fire telephone service, at a salary of $750.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING NOV. 10, 1885.

329,874 Electric time detector; Thomas Ahearn, Ottawa, Ontario, Canada.

329,887 Conduit for electrical conductors; Henry L. Caples and Wilber W. Lewis, Kansas City, Mo.

329,909 Telephone cabinet; Frank G. Johnson, New York, N. Y.

329,998 Electro-medical apparatus; Amandus Metzger, New York, N. Y.

329,956 Combined telegraphic and telephonic circuit; Abner M. Rosebrugh and Thomas R. Rosebrugh, Toronto, Ontario, Canada.

329,982 Receiver for telephonic telegraphs; Wm. A. West, Bellefontaine, Ohio, assignor to the West Telephone Co., Kenosha, Wis.

329,983 Telephone; Wm. A. West, Bellefontaine, Ohio, assignor to the West Telephone Co., Kenosha, Wis.

329,983 Telephonic telegraph; Wm. A. West, Bellefontaine, Ohio, assignor to the West Telephone Co., Kenosha, Wis.

330 037 Automatic circuit closer; Patrick C. F. McCambridge, St. Albans, Vt.

330,052 Electric arc lamp; Charles E. Scribner, Chicago, Ill, assignor to the Western Electric Co., Chicago.

330,053 Regulator for dynamo electric machines; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Co., Chicago.

330,054 Testing apparatus for lightning arresters; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Co., Chicago.

330,055 Electric arc lamp; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Co., Chicago.

330,056 Battery circuit for telephone exchanges; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Co., Chicago.

330,057 Telephone exchange signal; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Co., Chicago.

330,058 Operator's apparatus for telephone exchanges; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Co., Chicago.

330,059 Multiple switch-board testing apparatus; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Co., Chicago.

330,060 Operator's testing apparatus for multiple switch-boards; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Co., Chicago.

330,061 Multiple switch-board; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Co. Chicago.

330,062 Multiple switch-board; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Co., Chicago.

330,063 Operator's apparatus for telephone switch-board; Charles E. Scribner, Chicago, Ill., assignor to the Western Electric Co., Chicago.

FOR SALE CHEAP.

3 DYNAMOS,

2 Shunt, for 60 20-C. P. Lamps,

1 Series, 170 Volts and 19 Amperes.

Address ELECT. REVIEW OFFICE,

23 Park Row, New York.

WHITE

Oak Pins and Brackets

OF OUR OWN MANUFACTURE.

TELEPHONE SWITCHBOARDS, ELECTRIC BELLS, MEDICAL BATTERIES,

AND A FULL SUPPLY OF

Covered Wires and Electric Sundries

ALWAYS ON HAND.

Send for Catalogue.

DETROIT ELECTRICAL WORKS,

Cor. 7th and Woodbridge Streets,

DETROIT, MICH.

WOOD ENGRAVING ELECTROTYPING PRINTED SUPPLIES

Illustrations for Catalogues, Circulars, etc. The same compiled, printed, bound and mailed, if desired. Superior work guaranteed. Send for specimens and estimates.

A. MUGFORD, Hartford, Conn.

OUR "LIGHTNING SPEED INDICATOR"

Registers up to 1,000, will register 15,000 per minute. Spindle has rubber tip (patent applied for) to prevent slipping. Has silver plated dial and glass crystal, excluding dust. Spindle 1-2 in., 1 in., 2 in. or 3 in. as ordered. Sent by mail for $2.00. Discount to dealers. McDONNELL ODOMETER CO., 2 & 4 La Salle Ave., Chicago, Ill.

SUNLIGHT CARBONS!

MANUFACTURED BY THE

PARKER-RUSSELL Mining and Manufacturing Com'y,

711 Pine Street, - - - - - - - - - St. Louis, Mo.

100,000 CARBONS PER WEEK.

Using the purest materials and with machinery of our own invention,

Every Carbon is manipulated separately from the beginning of the operation until finished.

They are, therefore,

ABSOLUTELY UNIFORM AND EACH CARBON ALIKE IN ALL ITS PARTS.

In straightness, length of time in burning, brilliancy and steadiness of light they excel all others, and are adapted to the various systems of lighting in use.

MODEL ELECTRIC RAILWAY,

A complete working model Electric Railway, including Locomotive, Motor, two Cars, Track—four feet in diameter, powerful battery, and conductors.

Price Complete, $8.50.

A most instructive and amusing Toy.

An Edison 6-candle lamp can be run from the same battery, and will be sent on receipt of $1.50 extra.

THE STOUT-MEADOWCROFT CO.

Manufacturers of

ELECTRICAL GOODS,

Authorized agents of the Edison Lamp Co.,

P.O. BOX 2411. 21 ANN ST., N.Y.

OKONITE

CHARLES A. CHEEVER, President. WILLARD L. CANDEE, Treasurer.

THE OKONITE COMPANY,

Formerly New York Insulated Wire and Vulcanite Co.,

MANUFACTURERS OF

INSULATED WIRES AND CABLES,

No. 13 PARK ROW, NEW YORK.

ELECTRIC BELL OUTFIT

FOR

$2.50.

Comprising one walnut box bell, 2½-inch gong, one Leclanche battery, push button, 50 feet covered wire, box of staples.

Sent C. O. D. on receipt of one-third cash.

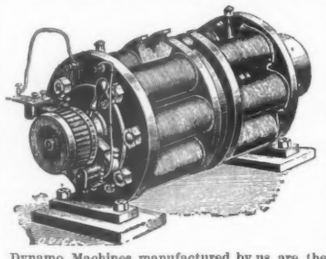
PROVIDENCE ELECTRICAL SUPPLY CO.,

56 Washington St., PROVIDENCE, R. I.

THE WARREN P. FREEMAN CO.

ELECTRICAL SUPPLIES,

106 & 108 LIBERTY ST., N. Y.



Dynamo Machines manufactured by us are the most reliable, and require less attention than any in the market.

Our Incandescent and Arc Lights are taking the lead throughout this country, and all work guaranteed satisfactory.

PAINE & LADD,

HALBERT E. PAINE, Late Commissioner of Patents. | STORY B. LADD.

Attorneys in Patent Causes And Solicitors of Patents.

WASHINGTON, D. C.

E. S. GREELEY & CO.,

Successors to

L. G. TILLOTSON & CO.,

MANUFACTURERS, IMPORTERS AND DEALERS IN

Telegraph, Telephone, & Electrical Supplies

OF EVERY DESCRIPTION,

5 and 7 DEY STREET, NEW YORK.

CABLES { Aerial, Submarine, Subterranean, &c.

WIRES { Line Wire, House Wire, Lead Wire, Insulated Wires, &c.

INSULATORS { Rubber Hook, Porcelain, Glass, &c.

CROSS ARMS { Pins, Locust and Oak, Rubber Hook Blocks, Brackets, &c.

ELECTRIC LIGHT, DISTRICT TELEGRAPH, BURGLAR ALARM SUPPLIES, &c.

Send for Estimates.

Gonda (formerly Prism) Battery, Complete. See that above label is on every jar

LECLANCHÉ GONDA BATTERY

(FORMERLY THE PRISM BATTERY).

THE STANDARD OPEN CIRCUIT BATTERY OF THE WORLD.

And beyond question the best for all purposes for which open-circuit batteries are required.

The Genuine Leclanché Gonda and Disque Cells are made only by us, and none are genuine without the Label, as shown in cut, and the

TRADE

GONDA.

MARK.

Price of the Gonda reduced to $1.20 per cell, complete

" " Disque " " 1.00 " " "

SEND FOR PRICE LIST, WITH DISCOUNTS.

THE LECLANCHÉ BATTERY CO.,

149 West 18th Street, New York.

Standard Electrical Works,

MANUFACTURERS OF

TELEGRAPH AND TELEPHONE APPARATUS,

Hotel and House Annunciators, Burglar Alarms,

CALL BELLS, "POST'S" MAGNETO BELLS,

PINS and BRACKETS, BATTERIES, &c., &c.

IN STOCK:—FULL LINE

IRON, STEEL and HARD-DRAWN COPPER WIRE, Delivered at Lowest Prices.

☞ ESTIMATES FURNISHED. SEND FOR CATALOGUES AND PRICES. ☜

Cincinnati, Ohio, U. S. A.

AMERICAN
Electric Mfg. Company.

EXECUTIVE OFFICES:

Western Union Telegraph Co.'s Building, cor. 23d Street and 5th Avenue,

FACTORY AND WAREROOMS:

163-165 WEST 18th STREET, N. Y.

This Company is engaged in the manufacture of DYNAMO MACHINES and LAMPS, and the construction of ELECTRIC LIGHTING STATIONS for lighting CITIES and TOWNS under the well-known

"AMERICAN SYSTEM"
OF ELECTRIC ARC LIGHTING,

(Wood's Patents.)

SPECIAL ADVANTAGES OF THIS SYSTEM. Completeness, durability, steadiness, quality of light and economy of power. The Wood dynamo-electric generator occupies less space, is lighter, requires less motive power, and costs less than others capable of producing an equal number of lights. There is less firing or flashing of the commutator, and consequently less loss of energy and wearing of the parts from this cause than is the case with other machines. It requires no oiling or other attention than to be kept clean, and its extreme simplicity enables it to be operated with the minimum of skill and attention. The current regulator and signalling apparatus, by which the machine is made to generate the exact current required for any number of lights from one to its full capacity—as they are turned off and on without change of speed or waste of power—is simple, effective, and safe. Its lamps are reliable in operation, the carbon-regulating mechanism being absolute in its control, durable, and unaffected by changes of temperature or weather. They are of ornamental design, and the steadiness and purity of light produced are unequaled at the same expenditure of power.

ESTIMATES FURNISHED For Central lighting stations, or isolated plants, for either the American Arc Lighting System or Edison Incandescent System, or for both combined.

SPECIAL ATTENTION given to installing isolated plants in Mills, Factories, Shops, Railroad Buildings, &c.

CONSTRUCTION WORK. Proper construction and installation of central stations and isolated plants is of great importance to insure safety and economy. The American Company has done more of this work than any other company in the United States, and its work is known to be superior to that of other companies.

PATENTS. This Company owns and controls all the Patents and Inventions for electric lighting of James J. Wood, J. B. Fuller, and many others heretofore controlled by the Fuller Electrical Co., and the Fuller-Wood Electric Light Co., which include the foundation patents of the Gramme dynamo.

"Among the different systems of arc lighting may be mentioned the Brush, the Weston, the Schuyler, the Thomson-Houston, and the Fuller-Wood (hereafter to be known as the American). The Fuller-Wood system of arc lighting has gained a world-wide reputation for reliability and economy. This organization was originally known as the Fuller Electrical Company, which dates its existence from 1878. This system was the foundation of the well-known Gramme Association, being the party of the first part in the articles of association, which was composed of the Brush, Weston, United States, Thomson-Houston, Edison and Jablaccoff companies, which was good evidence that all the companies composing that association were willing to pay tribute to the superior merit of the Fuller Wood system.—*N. Y. Sun, Sept. 27th*, 1885.

ILLUSTRATED PAMPHLET AND DESCRIPTIVE CIRCULAR FREE. ADDRESS,

AMERICAN ELECTRIC MFG. COMPANY,

Western Union Telegraph Building, cor. 23d Street and 5th Ave., New York.

HARD RUBBER.

For all Electrical Purposes. In Sheets, Rods, Tubes, and special designs as ordered when practicable. Rubber Hook Insulators, Window Tubes with Heads, Key Knobs, Switch Handles, Plug Handles, Battery Cells, Battery Syringes, Electric Lamp Switch Handles, &c., &c. Manufactured by

THE BUTLER HARD RUBBER COMPANY,

88 MERCER STREET, NEW YORK.

MULTIPLEX
MECHANICAL TELEPHONE.

The only Mechanical Telephone with Multiple Connections.

ADAPTED FOR WAREHOUSES, FACTORIES, APARTMENT HOUSES, ETC.

JOHN A. CABOT, Manager,

121 Tribune Building, NEW YORK.

The Brevoort Mfg. Co.,

MANUFACTURERS OF

THE ROBERTS

PERMANGANATE BATTERY.

This is the Best and the Cheapest Open-Circuit Battery in the market. It is far superior to any of the Sal-Ammoniac Cells Now in Use.

Electromotive Force, 1.8 Volt: Amperes, 2 5.

When the battery is exhausted all that is necessary is to supply a new solution; the battery is then as good as new. The zincs will last through two rechargings of the battery. Each cell, with a single charge of solution, will outlast and outwork any sal-ammoniac battery.

PRICE, Complete, . . . $1.

Liberal Discount to the Trade. Send for Price List and Descriptive Circular. Address office,

206 BROADWAY, NEW YORK.

FOR SALE ALSO AT

ELECTRICAL SUPPLY CO.,
17 Dey Street, New York.

E. S. GREELEY & CO.,
5 & 7 Dey Street.

The MATHER ELECTRIC CO.

Manufacturers of

COMPLETE SYSTEMS OF

ELECTRIC LIGHTING

16 x 24 DOUBLE BRAIDER.

NEW ENGLAND BUTT CO.,

Providence, R. I.,

MANUFACTURERS OF

BRAIDING MACHINERY

FOR COVERING

Telegraph, Telephone

AND

ELECTRIC-LIGHT WIRE.

ALSO

SINGLE AND DOUBLE

WINDERS AND BRAIDERS

Of every Description for Silk, Worsted and Cotton Braid.

FINE CASTINGS A SPECIALTY.

THE THOMSON-HOUSTON ELECTRIC CO.

Principal Office, 131 Devonshire St., Boston, Mass.,

FURNISHES THE

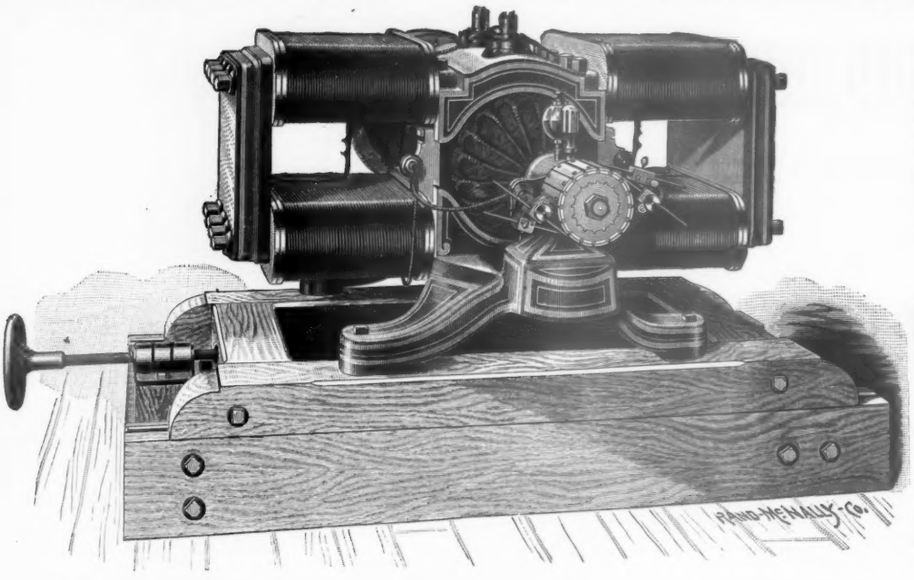
ONLY PERFECT AUTOMATIC, SELF-REGULATING SYSTEM OF ELECTRIC ARC-LIGHTING IN THE WORLD.

In all desirable qualities of ELECTRIC ARC LIGHTS the THOMSON-HOUSTON SYSTEM has no equal. The Lights are *superior in color and steadiness*, and the entire apparatus is more *economical, efficient* and *safe*, more *easily managed*, and *less liable to derangement* than any other.

THE THOMSON-HOUSTON ELECTRIC CO. was awarded the FIRST PRIZE for the *best system* of arc lighting, and the *best Arc Lamp*, at the Cincinnati Industrial Exposition of 1883.

The Thomson-Houston System has been awarded *superiority in all the competitive tests* to which it has been subjected. NEW ILLUSTRATED PAMPHLET will be sent on application.

WESTERN ELECTRIC COMPANY'S ELECTRIC LIGHTING APPARATUS



Every requisite for the most perfect system of Electric Lighting, at prices which insure a profitable investment to the purchaser.

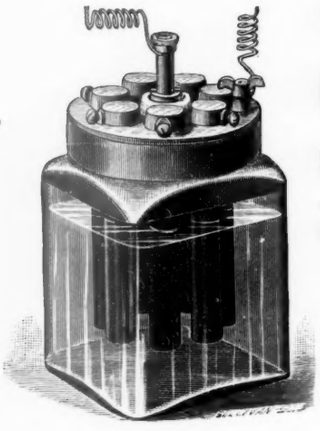
ADDRESS,

Western Electric Company,

CHICAGO OR NEW YORK,

MANUFACTURERS OF AND DEALERS IN ALL KINDS OF

Electrical Apparatus and Supplies.



The Electrical Supply Co.,

MANUFACTURERS OF

ELECTRICAL GOODS

OF EVERY DESCRIPTION.

INSULATED WIRES & CABLES A SPECIALTY.

LATEST IMPROVED

DIAMOND CARBON BATTERY

The neatest and most effective battery for Telephone Transmitters; Electric Bells, Electric Gas Lighting and all open-circuit work.

THE ELECTRICAL SUPPLY CO.,

WAREHOUSES:

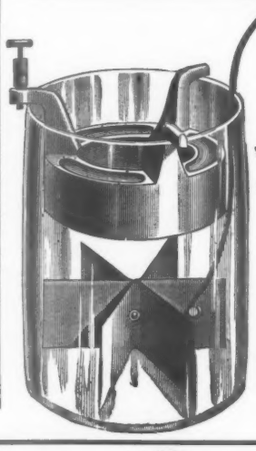
17 DEY ST., N. Y. 175-177 LAKE ST., CHICAGO.

FACTORY: ANSONIA, CONN.

MODEL and EXPERIMENTAL WORK A SPECIALTY. Send for Circulars. C. E. Jones & Bro. CINCINNATI, O. (Mention this Paper.)

Telegraph and Electrical SUPPLIES

Medical Batteries, Inventors' Models, Experimental Work, and fine brass castings. Send for catalogue C. E. JONES & BRO. Cincinnati, O. It is important to us that you mention this paper.



THE MORRISON

Gravity Battery

THE ONLY RELIABLE CLOSED-CIRCUIT BATTERY IN EXISTENCE.

After thirty years' experimenting with other batteries, The Gamewell Fire Alarm Telegraph Co. adopted it as their standard.

OFFICE OF THE GAMEWELL FIRE ALARM TELEGRAPH CO.,
1½ BARCLAY ST., NEW YORK CITY.
NEW YORK, August 14th, 1885.

THE SOUTHERN ELECTRIC CO., BALTIMORE, MD.

Gentlemen:—We have adopted the "MORRISON GRAVITY BATTERY" as the Standard Fire Alarm Battery for this company's service. After thirty years' experience we unhesitatingly endorse it as the best form of Gravity Battery ever devised.

Yours very truly, J. N. GAMEWELL,
General Superintendent Gamewell Police & Fire Alarm Telegraph Co.

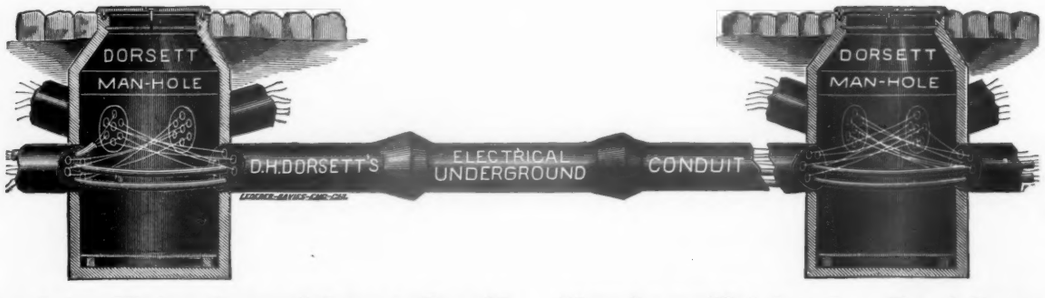
Manufactured only by

THE SOUTHERN ELECTRIC CO.,

Warerooms, Hoen Building, cor. North and Lexington Sts.; Works, cor. Constitution and Monument Sts.,

BALTIMORE, MD.

DORSETT'S UNDERGROUND CONDUIT SYSTEM.



Electrical Insulator, Water, Gas and Sewage Proof! Absorbs no Moisture! Frost Cannot Affect It!

CRUSHING STRAIN, 5,500 LBS. PER SQUARE INCH—GOVERNMENT TEST.

A Complete, Comprehensive System of Conduits for Electric Light, Telegraph, Telephone and Private Wires and Cables for Rental Purposes.

The 2¼-inch ducts in this Conduit are leased to different companies, which may then occupy them with such wires and cables as they may adopt. New wires may be introduced or old ones replaced through these ducts between the man-holes as shown in the cut.

An experience of six years for Underground Drainage has shown the superiority of this material as a resistant of moisture, and its consequent immunity from damage by frost. It has been in use for electrical purposes the past winter in the solidly frozen streets of Chicago without injury; is the system used by that city, giving perfect, unbounded satisfaction, and is now being introduced into the cities of St. Louis, Cincinnati and Detroit. The whole body of the Conduit is a thoroughly reliable insulator, unaffected alike by acids and alkalies. The cheapest and most perfect Conduit in the market to-day.

☞ CORRESPONDENCE SOLICITED. ☜

D. H. DORSETT, Proprietor, No. 61 La Salle Street, Chicago, Ill.

ROYCE & MAREAN,
DEALERS IN
ELECTRICAL APPARATUS,
Telegraph and Telephone Supplies,
No. 1408 Penna. Avenue,
Opp. Willard's Hotel, **WASHINGTON, D. C.**

H. M. RAYNOR,
No. 25 BOND ST., NEW YORK.
Established 1859.
PLATINUM IN All Forms FOR **ALL PURPOSES,**
WHOLESALE AND RETAIL.

JARVIS ENGINEERING CO.,
BOSTON, MASS.,
Contractors for
COMPLETE STEAM OUTFITS for Electric Lighting Stations,
Steel Boilers with Jarvis Furnaces to burn cheap fuels, ARMINGTON & SIMS' ENGINES, ETC.
SEND FOR CIRCULARS.

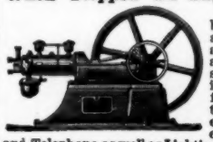
THE AMERICAN BELL TELEPHONE CO.

95 MILK STREET, BOSTON, MASS.

This Company owns the Letters Patent granted to Alexander Graham Bell, March 7th, 1876, No. 174,465, and January 30, 1877, No. 186,787.

The transmission of Speech by all known forms of Electric Speaking Telephones infringes the right secured to this Company by the above patents, and renders each individual user of telephones, not furnished by it or its licensees, responsible for such unlawful use, and all the consequences thereof, and liable to suit therefor.

"OTTO" GAS ENGINE
OVER 10,000 IN USE.
Started Instantly by a Match.
When Stopped all Expense Ceases.



Works without boiler, steam, coal, ashes or attendance. Successfully adapted instead of steam power in all industries and offers special advantages for running electrical machinery for Telegraph and Telephone as well as Lighting purposes.
Built in Sizes of 1, 2, 4, 7, 10, 15 & 25 ind. H. P.
SCHLEICHER, SCHUMM & CO.
N. E. cor. 33d & Walnut, Phila.
Branch Office: 214 Randolph Street, Chicago.

Incandescent Lamps,
From 8 to 150 C. P. (Battery Lamps from 1-2 to 8 C. P.) made in large quantities at short notice.
ADDRESS,
SUN ELECTRIC LIGHT CO.,
WOBURN, MASS.

SHEPARD'S $60. CELEBRATED
Screw-Cutting Foot Lathe.
CAP LATHE, $125.

Foot and Power Lathes, Drill Presses, Scrolls, Saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, &c. Send for catalogue of outfits for amateurs or artisans. Address,
H. L. SHEPARD, Agt,
134 E. SECOND STREET, CINCINNATI, O.

WORK SHOPS
WITHOUT STEAM POWER
BY USING OUTFITS OF
Barnes' Pat. Foot-Power

machinery can compete with steam power. Sold on trial. Metal and wood workers send for prices. Illustrated catalogue free.
W. F. & JNO. BARNES CO.,
Address No. 1995 Main St. Rockford, Ill.

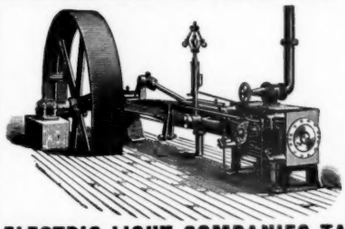
Telegraph and Electrical SUPPLIES
Medical Batteries, Inventors' Models, Experimental Work, and fine brass castings. Send for catalogue C. E. JONES & BRO. Cincinnati, O.
It is important to us that you mention this paper.

MAGNETO SIGNAL BELLS.
No Battery Required.

"STANDARD."

$4, $6, and upwards, according to style desired. Discount on large lots.
We make a specialty of the manufacture of these bells for Telephone Companies, and after an experience of many years, our facilities for the prompt execution of large orders are unequaled.
Close attention given to furnishing samples for special orders.
VIADUCT MANUFACTURING CO.
OF BALTIMORE.
A. C. DAVIS, President. A. B. PROAL, Secy. & Treas.
Office, North-West Corner Charles and German Streets,
ELECTRICAL GOODS OF EVERY DESCRIPTION.
Telephone, Telegraph, Electric Light, Fire Alarm and District Telegraph Supplies.
SEND FOR ILLUSTRATED CATALOGUE.

HARRIS-CORLISS STEAM ENGINE
BUILT BY
WILLIAM A. HARRIS,
PROVIDENCE, R. I.



From 10 to 2000 Horse Power, with Harris's Improvements. These Engines are of
UNEXCELLED WORKMANSHIP,
and are known the world over as the
MOST ECONOMICAL STEAM ENGINE BUILT.
ELECTRIC LIGHT COMPANIES TAKE NOTICE! They are especially adapted for all purposes where continuous service at uniform speed is required and at the minimum of cost of repairs.
Send for a copy of Engineers' and Steam Users' Manual by J. W. Hill, M. E. Price, $1.25.

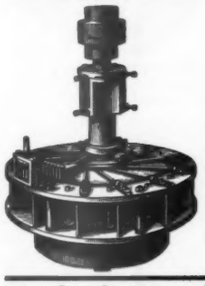
NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.
In Use Over 800.
25 to 1,000 H. P.

These Engines are the combined result of long experience with automatic cut-off regulation and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-Contained Automatic Cut-off Engines, 12 to 100 H.P. for driving Dynamo Machines a SPECIALTY.—Illustrated Circulars with various data as to practical Steam Engine Construction and performance, free by mail. Address
BUCKEYE ENGINE CO., Salem, O.
SALES AGENTS:
Geo. A. BARNARD, 70 Astor House, N. Y., and 53 Mason Building, Boston, Mass.
D. L. DAVIS, 84 S. Canal St., Chicago, Ill. and ROBINSON & CAREY, St. Paul, Minn.

VICTOR
Turbine Water Wheel.

The attention of **Electric Companies** is called to this **celebrated water wheel** as particularly adapted to their use, on account of its **remarkably steady motion, high speed** and **great efficiency,** and **large capacity** for its **diameter,** being **double** the **power** of most **wheels** of **same diameter.** It is used by a number of the leading electric companies with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent. of useful effect, **guaranteed.**
SEND FOR CATALOGUE AND PARTICULARS.
STILWELL & BIERCE MFG. CO.,
DAYTON, OHIO.
(Please Mention this Paper.)

James Leffel's IMPROVED WATER WHEEL.



Made by JAMES LEFFEL & CO.
The "OLD RELIABLE" with Improvements, making it the **Most Perfect Turbine now in use,** comprising the **Largest** and the **Smallest** Wheels under both the **Highest** and **Lowest** Heads in this country. Specially adapted for running Electric Dynamos on account of the great steadiness of its motion. Our new Pocket Wheel Book sent free. Address
JAMES LEFFEL & CO.,
Springfield, Ohio, - AND - 110 Liberty St., New York.
[Please mention this paper when your write to us.]

REMINGTON
Standard Type-Writer.

Ask for Particulars Regarding the Use of the Remington Type-Writer in Receiving Messages.
WYCKOFF, SEAMANS & BENEDICT, 339 Broadway, New York.

Poole & Hunt's Leffel Turbine Water Wheel.
Made of Best Materials and in the Best Style of Workmanship.
MACHINE-MOLDED MILL GEARING,
From 1 to 20 feet diameter, of any desired face or pitch, molded by our own special machinery.
SHAFTING, PULLEYS AND HANGERS
Of the latest and most improved designs.
Transmission Machinery
A SPECIALTY.

Special attention given to Heavy Gearing. Shipping facilities the best in all directions.
POOLE & HUNT, Baltimore, Md.

Schuyler Electric Light Co.,
Manufacturers of
DYNAMO MACHINES
FOR INCANDESCENT AND ARC.
The most perfect system of both Incandescent and Arc Lighting. Entire freedom from hissing and flickering in our Arc Lights, and long life and great brilliancy in our Incandescent Lights.
Dynamo Machines with perfect automatic regulation, reliable and efficient.
Prices moderate. Estimates made for lighting from Central Stations or for isolated plants. Illustrated Circulars sent upon application. Address
New York Office: 44 BROADWAY
SCHUYLER ELECTRIC LIGHT CO.,
Hartford, Conn.

TRIPLEX INSULATED

Wire and Rubber Co.

Superior Quality of Insulation

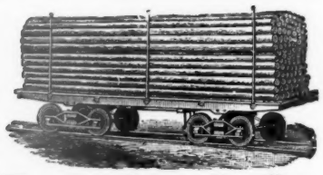
ON ALL CLASSES OF

Electric Wires

—AND—

CABLES.

Address, 159 FRONT ST., New York City.



Brownlee & Co.,

DETROIT, MICH.

DEALERS IN

Cedar Telegraph Poles

MANUFACTURERS OF

Cross Arms, Pins and Brackets,

OAK AND LOCUST PINS,

BROWNLEE'S CONCAVED BRACKET.

(Patent applied for.) Send for Catalogue.

American Electrical Works

MANUFACTURERS OF

Patent Finished Insulated Electric Wires,

TELEPHONE AND ELECTRIC CORDAGE,

ELECTRIC LIGHT WIRE

MAGNET WIRE.

PATENT RUBBER COVERED WIRE, OFFICE AND ANNUNCIATOR WIRE, LEAD-ENCASED WIRE ANTI-INDUCTION AERIAL AND UNDERGROUND CABLES ETC., ETC.

OFFICE AND FACTORY:

No. 67 STEWART STREET,

PROVIDENCE, R. I.

EUGENE F. PHILLIPS, President.

W. H. SAWYER, Secretary and Electrician.

The Best and most Complete Book on Electro-Metallurgy in any language.

Wahl's Galvanoplastic Manipulations

RECENTLY PUBLISHED.

Galvanoplastic Manipulations. A Practical Guide for the Gold and Silver Electroplater and the Galvanoplastic Operator. Comprising the Electro-Deposition of all Metals by means of the Battery and the Dynamo-Electric Machine, as well as the most approved Processes of Depositions by Simple Immersion, with descriptions of Apparatus, Chemical Products employed in the Art, etc. Based largely on the "Manipulations Hydroplastiques" of Alfred Roseleur. By William H. Wahl, Ph. D. (Heid.) Secretary of the Franklin Institute. Illustrated by 189 engravings. 8vo. 656 Pages. Cloth, - - - $7.50

By mail free of postage to any address in the world.

☞ *A full descriptive and illustrated circular of the above work sent free of postage to any one who will apply.*

☞ *Our Catalogue of Practical and Scientific Books, 96 pages, 8vo, and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.*

HENRY CAREY BAIRD & CO.,

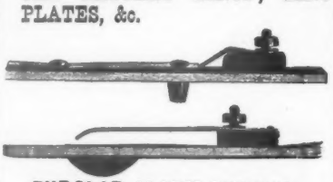
INDUSTRIAL PUBLISHERS, BOOKSELLERS & IMPORTERS.

810 Walnut Street, Philadelphia, Pa.

ZINCS

LECLANCHE ZINCS, with thumb screw or patent spring connections, from pure spelter, and well amalgamated.

BUNSEN BATTERY ZINCS; MEDICAL BATTERY ZINCS; ZINC PLATES, &c.



BURGLAR ALARM SPRINGS,

A new and reliable spring, with rubbing contacts, open or closed circuits.

Electric Bells of every description. Batteries & Supplies.

The Conn. District Telegraph & Electric Co.,

22 Bank St. - - - - - - Waterbury, Conn.

Telegraph and Electrical SUPPLIES

Medical Batteries, Inventors' Models, Experimental Work, and fine brass castings. Send for catalogue C. E. JONES & BRO. Cincinnati, O.

It is important to us that you mention this paper.

PHOSPHOR-BRONZE TELEPHONE WIRE,

Insulated and Bare.

"Phosphor-Bronze."

Combines High Electrical Conductivity and Resistance to Corrosion with Lightness and Tenacity.

Standard Sizes, 16, 17, and 18, Stubs' Gauge.

ADDRESS;

The Phosphor-Bronze Smelting Co. (limited,)

512 ARCH ST., PHILADELPHIA, PA.

Owners of the United States Phosphor-Bronze Patents.

Sole Manufacturers of Phosphor-Bronze in the United States.

CONNOLLY BROS.,

Patent Attorneys

AND SOLICITORS,

Pittsburgh, Pa.;

PHILADELPHIA, PA.,

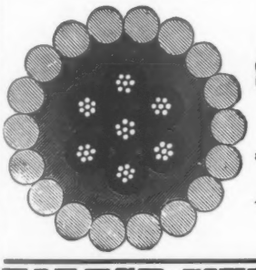
Mutual Life Ins. Building, 10th and Chestnut Sts.;

WASHINGTON, D. C.,

CORNER 6th AND F STREETS.

Electrical Cases a Specialty.

THE BISHOP GUTTA-PERCHA CO.,



420 to 426 East 25th St., N. Y.,

Have improved machinery and increased facilities for making

Submarine, Subterranean and Aerial Cables.

We guarantee our productions

TO BE SUPERIOR TO ANY IMPORTED,

and to sell at prices which will render importation unnecessary. All the *GUTTA-PERCHA* insulated cables made in this country have been manufactured at our works.

All kinds of Insulated Wires at the Lowest Prices.

PURE GUTTA-PERCHA FOR ALL PURPOSES.

W. W. MARKS, Supt. HENRY A. REED, Sec'y.

Disque Leclanché Battery

A SAVING OF TWO-THIRDS OF THE COST OF TRANSMITTER BATTERIES.

The particular attention of telephone companies is called to the great economy involved in the use of "**DISQUE**" over any other form of **Leclanche Battery**; its present low cost being such that, in quantity, the *Complete* Disque Cell is furnished for the price of a single pair of prisms, while instead of requiring renewal once every four to six months, the Disque Porous Cup does first class transmitter and bell work for from 18 to 30 months.

The renewal of the porous cup costs but little more than half the price for prisms.

A number of the largest telephone companies in the United States have already availed themselves of this plain advantage, and are using our Disque Battery exclusively.

As to the many other forms of Sal Ammoniac-Carbon-Zinc, "Open Circuit," and "Telephone Batteries," it is quite apparent that their only advantage existed while high prices were charged for Disque Leclanché Battery. Now that the Disque, which is the *foundation* Sal Ammoniac Battery, and the best of any or all, has also become the cheapest, there can be no question as to the entire economy of its use above all others.

PRICES

BATTERY, COMPLETE,	$1.00	ZINC, WITH CONNECTOR,	$ .10
POROUS CUP, - - .	.75	SAL AMMONIAC, - -	.08
GLASS JAR, - - -	.18	COMPLETE CELL, SEALED,	1.20

LARGE DISCOUNTS TO TELEPHONE EXCHANGES AND THE TRADE.

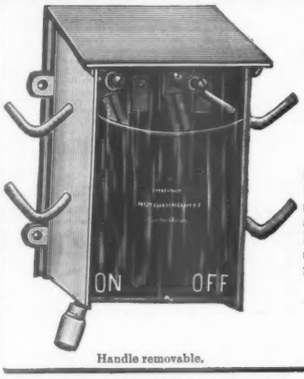
All Disque Leclanche Batteries furnished by us are warranted to be in every particular the same original and genuine article which has during the past ten years become thoroughly well known as the best of all Open Circuit Batteries.

J. H. BUNNELL & CO.,

Nos. 106 & 108 LIBERTY STREET, NEW YORK.

SEND FOR OUR LATEST LARGE ILLUSTRATED CATALOGUE, NO. 7, OF JULY, 1885.

FOREST CITY ELECTRIC WORKS,



Handle removable.

SOLE MANUFACTURERS OF

CLEVELAND'S ELECTRIC LIGHT CUT-OUTS,

GANG SWITCHES,

AND OTHER ELECTRIC LIGHT SUPPLIES,

In stock and to order. Contracts made for special manufacture and for the exclusive use or sale of any Electrical apparatus. (Electric Light a specialty). Descriptions and prices on request.

Correspondence Solicited.

W. B. CLEVELAND, Prop.

144 SUPERIOR ST., CLEVELAND, O.

"THE ELECTRICAL REVIEW,"

An illustrated weekly journal, is the acknowledged leader in the world of electrical science. Edited with care, its editorial opinion is reliable, its news columns bright and instructive. $3.00 per year; single copies, 10 cents.

29 PARK ROW, NEW YORK.

☞ Best advertising medium in the electrical field.

MODEL and EXPERIMENTAL WORK A SPECIALTY. Send for Circulars. C. E. Jones & Bro. CINCINNATI, O. (Mention this Paper.)

MITCHELL, VANCE & CO.,

GAS FIXTURE MANUFACTURERS,

Have added a department for the Manufacture of Electroliers and other fixtures adaptable to any system of Incandescent Electric Lighting, also Combination Fixtures for both Gas and Electric Light. Estimates and designs furnished upon application.

836 & 838 BROADWAY, NEW YORK.

Lowest Prices FOR

BELLS,

E. W. HAZAZER,

33 Murray St., N. Y.

ALFRED F. MOORE.

MANUFACTURER OF

Insulated Wire,

For Telephone, Telegraph and Electric Light.

OFFICE, LINE,

AND

ANNUNCIATOR WIRE,

Magnet Wire and Flexible Cordage,

200 & 202 N. THIRD ST.,

PHILADELPHIA, PA.

BOULTON CARBONS

These carbons are made of the
FINEST MATERIALS,
and with the latest improved machinery, of **any required degree of hardness,** and can be used in all makes of Electric Lamps.
The regular sizes, 12 inches long, run from ¼ inch to 1 inch diameter, varying by sixteenths.
Special LENGTHS and SIZES to Order.
A large and complete stock always on hand.
The want of a high order of battery plate has long been felt. Those wishing such would do well to use the
BOULTON PLATES.
Special attention is given to the manufacture of all sizes to order.
Price Lists and full information furnished on application.
Also Exclusive Agents of the celebrated
AUSTRIAN Cored CARBON
for the United States.

BOULTON CARBON WORKS,
Foot of Wilson Avenue,
CLEVELAND, OHIO.

Telephone Stocks
—AND—
Chicago Local Stocks & Bonds
BOUGHT AND SOLD
On Commission by the Undersigned.
S. G. LYNCH,
144 La Salle St., Chicago (formerly Lynch & Banta).

Established 1866. 357 FOURTH AV., N. Y.
CURT W. MEYER,
Manufacturing Electrician and Inventor of
The unprecedented "CURT BATTERY" in great demand.
"The Student's Electrical Cabinet," an instructive gift. Electro-Medical Batteries, Electric Illuminators, and all kinds of electrical supplies, Optical Goods, etc.
☞ *SEND FOR CIRCULARS.*

STANDARD ELECTRICAL INSTRUMENTS.
Galvanometers, Resistance Coils, Condensers, Keys, Switches, &c., Bailey Combination Set, Pratt's Speed Indicator, &c.
ELECTRIC MFG. CO.,
P. O. Box 80, Troy, N. Y.

STAR IRON TOWER CO.
Manufacturers of the
O'Beirne Patent
TOWERS AND MAST ARMS
FOR
Electric Lighting,
and Publishers of the
AMERICAN ELECTRICAL DIRECTORY
Fort Wayne, Indiana.

CARBONS
FOR ARC LIGHTING.
Only Manufacturers using Natural Gas, thus securing
Uniformity, Durability & Superior Light.
PITTSBURGH CARBON CO., lim'd,
PITTSBURGH, PA.

And 175 and 177 LAKE STREET, CHICAGO.

STANDARD UNDERGROUND CABLE COM'Y,
MANUFACTURERS OF
The WARING ANTI-INDUCTION and BUNCHED
Telegraph, Telephone and Electric Light, Underground and Submarine
CABLES,
LEAD COVERED WIRE FOR INSIDE USE, PROOF AGAINST DAMPNESS.
No. 128 Pearl St., New York City. {All Work Guaranteed.} No. 88 Fourth Ave., Pittsburgh, Pa.

Consolidated Electric Light Co.,
Owning and Operating the
SAWYER-MAN PATENTS.

EXECUTIVE OFFICES:
Mutual Life Building,
NEW YORK.
PHILADELPHIA OFFICE:
205 Walnut Street;
BOSTON OFFICE:
4 Pearl Street.
CHARLES H. BANES, President.
HUGH R. GARDEN, Vice President.
HENRY C. DAVIS, Treas. and General Manager.
Plans and Estimates Furnished for all kinds of INCANDESCENT LIGHTING.
ESTIMATES FURNISHED for the Thomson-Houston System of Arc Lighting.

Electric Light.
HENRY C. REES,
730 Sansom St., Philadelphia, Pa.,
Undertakes the Furnishing and Erection of Electric Light Plants of every system.
Incandescent Wiring and Repairs to Dynamos and Lamps a specialty.
Estimates furnished on application.

UNION SQUARE HOTEL,
AND HOTEL DAM,
HEADQUARTERS:
Telephone, Telegraph and Electric Light People.
A. J. DAM & SON, Proprietors,
Union Square, cor. 15th Street, New York.

The Bergmann 'Telephone' Battery.

THE BEST
Open-Circuit Battery
IN THE MARKET.
Superior to the Leclanché & all others for Telephone Work, Annunciators, Burglar Alarms, Gas Lighting, etc., etc., in short for all kinds of open circuit work.
PRICE, (complete) $1.00.
Liberal Discount to dealers and large consumers.
Send for Circular and Price List.
BERGMANN & COMPANY,
Electrical Works,
292, 294, 296, 298 Ave. B, New York, N. Y.

HENRY B. LYTLE. GEO. L. BEETLE.
LYTLE AND COMPANY,
15 CORTLANDT STREET, NEW YORK.
MANUFACTURERS' AGENTS.
Electrical Supplies and Apparatus
OF EVERY DESCRIPTION.
LICENSEES
TELEGRAPHIC TIME COMPANY
In States of New York, New Jersey, Penn., Ohio, Indiana, Missouri, Wisconsin, Minnesota and Kansas.
Information Furnished Upon Application.

WARNER'S PATENT ELECTRIC GAUGE
FOR INDICATING THE STRENGTH OF
BATTERY CURRENTS,
SIMPLE, ACCURATE, RELIABLE.

The condition of a cell of battery or the strength of a battery current passing over a line can be ascertained in a moment by the most inexperienced.
INVALUABLE FOR TELEPHONE, ELECTRIC CLOCK, FIRE ALARM OR OTHER ELECTRIC SERVICE.
Full particulars by mail on application.
LYTLE & CO.,
SOLE AGENTS,
No. 15 Cortlandt Street, New York.

MODEL and EXPERIMENTAL WORK A SPECIALTY.
Send for Circulars.
C. E. Jones & Bro.
CINCINNATI, O.
(Mention this Paper.)

B. TROPP,
The Cheapest House in the Trade for
ELECTRIC BELLS,
RUHMKORFF SPARK COILS.
285 Atlantic Avenue, Brooklyn, L. I.

THE
United States Electric Lighting Co.
SOLE MANUFACTURERS OF
WESTON
DYNAMO MACHINES
FOR BOTH
Arc and Incandescent Lighting and Electroplating.
WESTON + ARC + LAMPS,
Weston Incandescent Lamps,
ELECTRIC MOTORS, AUTOMATIC REGULATORS,
Fixtures, Fittings, &c.
THE WESTON SYSTEMS OF
Arc and Incandescent Lighting
ARE SUPERIOR TO ALL OTHERS IN
EFFICIENCY, SAFETY, RELIABILITY AND
Perfection of Automatic Regulation.
Full information with prices and Estimates furnished upon application.
General Office, 59 & 61 Liberty St., New York.
Chicago Office, 185 LA SALLE STREET.

TELEGRAPHIC TIME COMPANY,

14 & 15 TEMPLE COURT, 5 BEEKMAN ST.

NEW YORK.

OWNERS OF PATENTS COVERING THE ONLY COMPLETE ELECTRIC TIME SYSTEM, WHICH HAS BEEN SUCCESSFULLY OPERATED ON AN EXTENSIVE SCALE, IN THE WORLD.

THIS Company, recently organized, has acquired all the Patents and Contracts of the TIME TELEGRAPH COMPANY and a large number of valuable and entirely new base patents covering Electro-Mechanical Clocks and Synchronizing Devices. Two years of service in New York, Boston, Providence and other large New England Cities have demonstrated the perfect reliability of this System. Highest testimonials at the Philadelphia Electrical Exposition and from Electrical Experts and practical Clock Manufacturers and Dealers, also from subscribers who are using the System in 20 of the prominent cities of the United States.

TERRITORIAL RIGHTS FOR SALE UPON LIBERAL TERMS. CORRESPONDENCE SOLICITED IN RELATION TO THE INTRODUCTION OF THE BUSINESS INTO PORTIONS OF THE UNITED STATES FOR WHICH LICENSES HAVE NOT BEEN GRANTED.

38 Conductor Aerial Telephone Cable.

DAY'S Kerite Insulated WIRES AND CABLES

For Telephone, Telegraph and Electric Light Use and Electrical Circuits Generally.

The reliability and durability of Kerite Insulation is unsurpassed, as has been proven by years of experience. All rubber and gutta-percha compounds are very short-lived when placed either in the air or underground, and the supposed new insulating materials now being presented to the public, are most of them old and discarded experimental products. The present high standard and uniform quality of Kerite is the result of 30 years' experience.

The attention of TELEPHONE MANAGERS is especially asked to our ANTI-INDUCTION TELEPHONE CABLES, they being the most practical and durable in the market.

TELEGRAPH, TELEPHONE and ELECTRIC LIGHT Wires, for either SUBMARINE or UNDERGROUND work a specialty. Estimates for complete systems of underground wires and conduits will be furnished on application.

AUSTIN G. DAY, Sole Manufacturer.

CLARK B. HOTCHKISS, Gen'l Agent,

120 BROADWAY, NEW YORK.

THE BEST IS THE CHEAPEST.

The Brush-Swan Electric Light Co. of New England.

W. L. STRONG, President. C. P. WHITNEY, Secretary.
A. D. JUILLIARD, Vice-President. R. W. ABORN, Treasurer.
JOHN B. POWELL, General Manager.

REMOVED TO Nos. 204, 206, 208, 210 ELIZABETH ST., NEW YORK.

WHERE ELECTRICAL APPARATUS FOR ALL THE VARIOUS MODES OF LIGHTING AND TRANSMITTING OF POWER ARE IN OPERATION.

NO OTHER SYSTEM IS AS ECONOMICAL IN INSTALLATION AND MAINTENANCE.

NO OTHER ELECTRIC LIGHT APPARATUS IS AS DURABLE.—THE FIRST MACHINES MADE ARE STILL IN DAILY OPERATION.

THE SYSTEM COMPRISES:
- Arc Lights of various Sizes.
- Arc and Incandescent Lights from one Dynamo and Circuit.
- Incandescent Lights of various Sizes from Special Dynamo for Central Station Lighting.

Cost of Apparatus Greatly Reduced. Surveys and Estimates Furnished by Experts.

☞ This company owns and controls all the Patents for ARC LIGHTING issued to CHAS. F. BRUSH, of Cleveland, for the New England States, New York, Pennsylvania, New Jersey, Delaware, Maryland, and the District of Columbia; also the Swan Patents for the same territory.

G. W. STOCKLY, President. J. J. TRACY, Vice-Prest. W. F. SWIFT, Secretary.
J. POTTER, Treasurer. N. S. POSSONS, Supt. W. A. POSSONS, Asst. Supt.

THE BRUSH ELECTRIC CO.,

The Sole Manufacturers, under all the patents of Charles F. Brush, for Electric Lighting, Storage Batteries, Carbons, Electro-Plating Machines, Electric-Motors, &c.

WE FURNISH the ONLY COMPLETE and PERFECT SYSTEM OF ELECTRIC LIGHTING.

Machines for Arc Lighting, giving lights of 1,200, 2,000, 3,000, 4,000 and up to 100,000 candle power. Our No. 8 machine gives 65 lights of 2,000 c. p. with about 45 H. P.

Over twenty different styles of arc lamps, for indoor and outdoor use, and for tower lighting.

MACHINES FOR INCANDESCENT LIGHTING,

adapted for use with Swan Incandescent lamps. These machines are automatic and do not require the use of any switches or resistances outside of the machine to govern the current. Will run any number of lamps from one up to the full capacity of the machine, without change of speed and without the use of any apparatus outside of the machine.

Our prices are lower than other makers.

Storage Batteries, for Incandescent Lighting and for Electric Motors. Our storage batteries are the only practical ones offered in the market. They are especially adapted for situations where lights are needed for only four or five hours per day and where it is convenient to use power during the day to store up the current. There are thousands of such places where our storage battery must eventually be used.

CARBONS FOR ARC LAMPS.

Our carbons are the purest and best made. We have the largest and most fully equipped carbon factory in the world and our prices are very low.

ELECTRIC MOTORS.

We have commenced the manufacture of the Brush Electric Motors and shall soon be prepared to fill orders for all sizes from one up to forty horse-power. In many locations these are the most economical producers of power and will be largely used by Lighting Companies and others where small powers are required.

THE BRUSH ELECTRIC CO., *104 EUCLID AVENUE, Cleveland, O., U. S. A.*

ANSONIA BRASS & COPPER CO.,

Manufacturers of

Pure Electric Copper Wire,

BARE AND COVERED, OF EVERY DESCRIPTION.

"ACME" BRONZE TELEGRAPH AND TELEPHONE WIRE.

Warerooms: 19 & 21 Cliff St., New York. Factories: Ansonia, Conn.

HOLMES, BOOTH & HAYDENS,

Manufacturers of

Hard-drawn Copper Wire

For Telegraph and Telephone.

Patent Electric Light Wire, Magnet Wire,
Patent "K. K." Copper and Iron Wire, &c.

Sole Agents for the

Forest City Carbon Mfg. Co.

NEW YORK, BOSTON AND PHILADELPHIA. FACTORIES: Waterbury, Conn.

BRIDGEPORT BRASS CO.,

BRIDGEPORT, CONN.,

INCORPORATED 1865.

BRASS, COPPER AND GERMAN SILVER

WIRE AND ROLLING MILLS,

Bare and Insulated Copper Wire for Electric Conductors a specialty.

SOLE AGENTS FOR THE

BRIDGEPORT ELECTRIC MFG. CO.

The Armington & Sims

AUTOMATIC CUT-OFF ENGINE.

For all purposes where power is required.

CLOSE REGULATION,
ECONOMICAL OF FUEL,
SMALL SPACE REQUIRED,
MODERATE PRICE.

Over 1700 Engines in Use.

SELLING AGENTS:

JARVIS ENGINEERING CO., 61 Oliver St., Boston.	T. W. ANDERSON, New Orleans, La.
POND ENGINEERING CO., St. Louis, Mo.	E. P. HAMPSON & CO., 36 Cortlandt St., New York.
J. F. RANDALL, Warren, Ohio.	TANNER & DELANEY ENGINE CO., Richmond, Va.
JOHN R. MARKLE, Detroit, Mich.	MORTON, REED & CO., Baltimore, Md.
H. B. SMITH MACHINE CO., 925 Market St., Phil., Pa.	WM. MINNIGERODE, Atlanta, Ga.
F. H. HAYWARD, 56 Dearborn Street, Chicago, Ill.	

Shultz Belting Company,

MANUFACTURERS OF

SHULTZ PATENT FULLED LEATHER BELTING AND LACE LEATHER.

Office and Factory: Cor. Bismarck and Barton Sts., St. Louis, Mo.

Our Belting is made of leather tanned on the surface only; the interior (which is the fiber and strength of the hide) is not tanned, but rawhide fulled and softened by our patented process. Our Belting is more pliable, hugs the pulley better, transmits more power than any other, and is the only perfect ELECTRIC LIGHT BELT MADE. Agents in all cities. Send for trial belt.

THE ELECTRICAL SUPPLY CO.

MANUFACTURERS OF

Insulated Wire

OF EVERY DESCRIPTION.

ELECTRIC LIGHT, TELEPHONE, AND TELEGRAPH SUPPLIES.

Warehouses: 17 DEY ST., NEW YORK. 175 & 177 Lake St., Chicago.

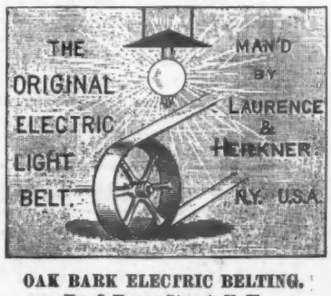
CARHART'S

Aerial Cable Clip,

THE BEST IN THE MARKET.

SEND FOR SAMPLE AND PRICES.

PROVIDENCE ELECTRIC SUPPLY CO., Providence, R. I.



OAK BARK ELECTRIC BELTING. No. 8 Verry Street N. Y.